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POWER TOPICS CROSS-INDEX

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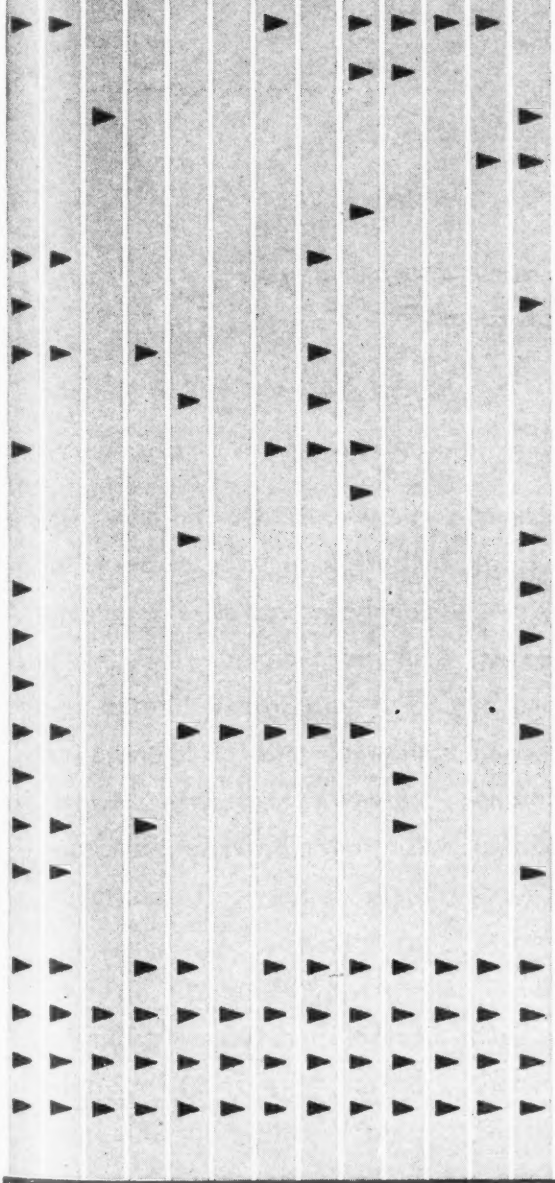

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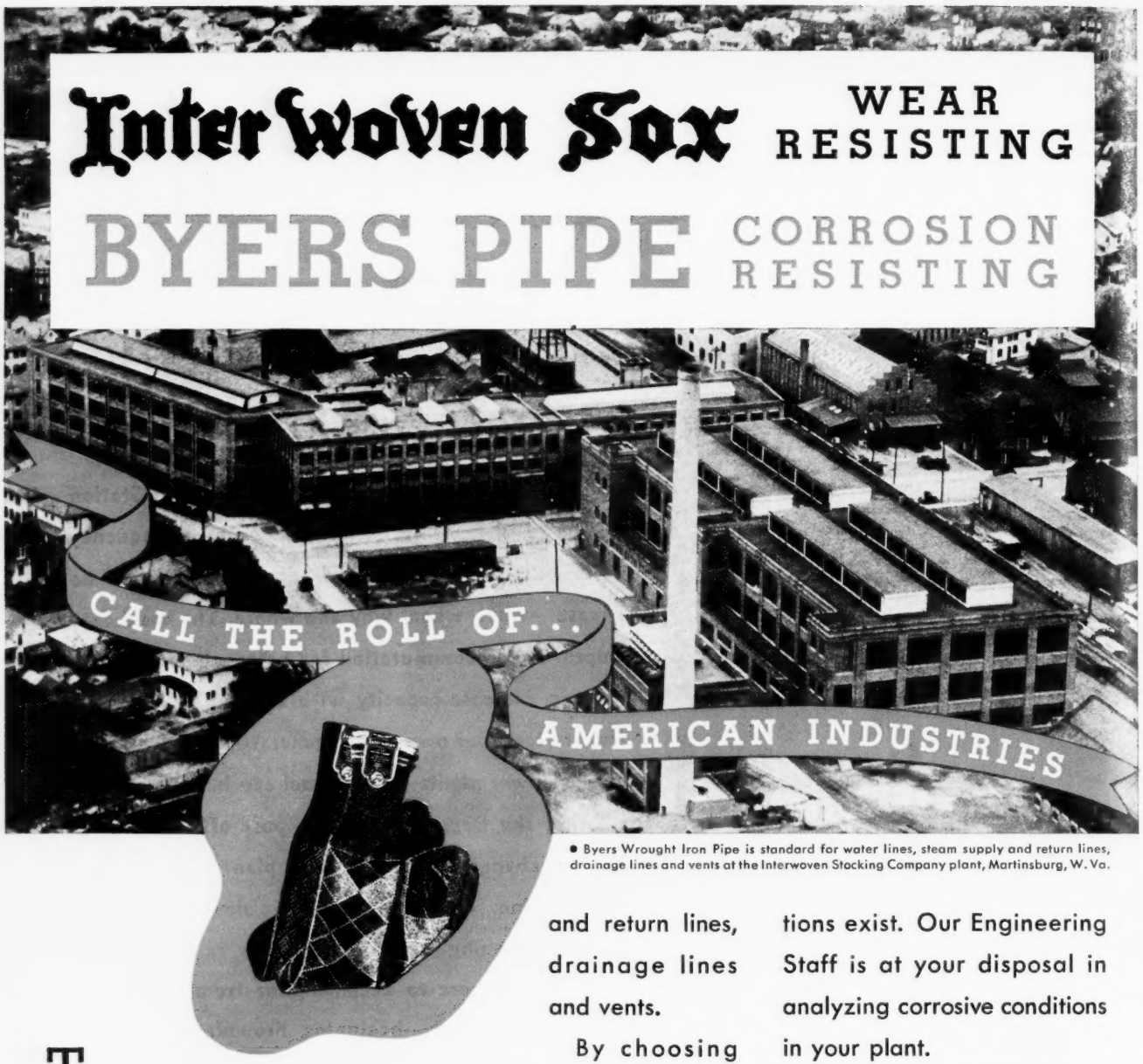

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•

OVER the FENCE

Is MODERNIZATION a fetish or sound business policy under today's difficult conditions? On the chance that some people have been over-enthusiastic, let's climb over the fence and pick up the arguments against modernization, like this:

"People are always coming around and bothering me and telling me I ought to modernize my plant. One wants to put in a new boiler or engine, which he says will pay for itself out of savings. Another says a new stoker will cut my fuel bill 20%. Another claims that instruments will save their cost in a year.

"Now I'll grant that many of these things will make savings, but aren't the claims greatly exaggerated? How do I know that I can actually make the savings these fellows promise?

"Business has been picking up, but many national issues are disturbing. I'd better wait a few months to see whether the present business improvement holds. Our company's cash position is good, but we can't spare any working capital to buy new equipment. What we do spend I think we'll probably put into manufacturing units, where they will earn real money. You see, I've been told that power is only 5% of our manufacturing cost.

"It's all right to talk of the ease of borrowing money, but I've found the bankers viewing loans with one eye on 100 per cent security and the other on the bank examiner. All things considered, I think I'll just sit tight."

That's a pretty fair sample of the stories from the other side of the fence, isn't it? And there's a bit of truth in them too. For example, there *are* those sellers who exaggerate savings, and point to exceptional examples of improvement as typical. But this merely means that the owner should depend on a really competent engineer, one with eyes and ears of his own, one who knows what other engineers have done in other plants. Such a man will take these claims of savings as mere leads and run down the facts for himself. He will seek disinterested advice. And if he is worth having, his findings will command consideration.

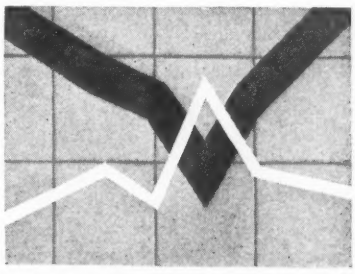
Now, as to business. Is it better? All observers say yes, definitely. Will improvement continue? Most authorities believe that it will. No need to argue how steep the rise will be, because the modernizations urged are those that will pay 25 to 100% yearly return at *present* levels of activity.

There can be no argument against spending money on production machines *if* the return is high enough and not dependent on future sales or other unknown business factors. But remember that $5,000 saved on power is a clear $5,000 added to net profit, whether power cost is 5% or 25% of total manufacturing cost.

How about the bankers? Has their attitude toward industrial loans changed? The answer is definitely yes in many banks that have been lending to home owners with the insurance backing of the Federal Housing Administration. This insurance has now been extended to protect these same banks when they lend from $2,000 to $50,000 for industry modernization. Industry loans they make under F.H.A. are acceptable to bank examiners. Naturally the bankers have good reason to be more liberal.

For specific data on the F.H.A. insurance of loans, see the first three pages of July *Power*. Briefly, it provides money from your local banker, without red tape, at moderate interest rates, and to be repaid in instalments. If you'd rather not touch your reserves, an F.H.A.-guaranteed loan may be the answer. In any case, the possibility serves as a good excuse for reopening the whole question of modernization.

From every angle, modernization for immediate and continued savings is today's sensible step toward business profit and business security.



165,000 KW. MORE IN RICHMOND

Install 165,000 kw. capacity in space originally for 50,000 kw.; use Aroclor fluid in turbine governor

WHEN built, Philadelphia's Richmond Station, described in *Power* May 18, 1926, was planned to contain four 50,000-kw. turbine-generators and 24-stoker-fired boilers, each capable of producing 200,000 lb. of steam per hour at 375 lb. pressure and 675 deg. Two units, since re-rated to 60,000 kw. and 12 boilers were installed, but the building was completed for the 4 units and necessary boilers, with the expectation that within 2 yr. a third unit would be required.

Decision to develop the Conowingo hydro-electric station, made about the time Richmond Station was placed in operation, and the later acquisition of capacity at the Deepwater, N. J., plant together with the several years of business depression, postponed requirements for additional capacity.

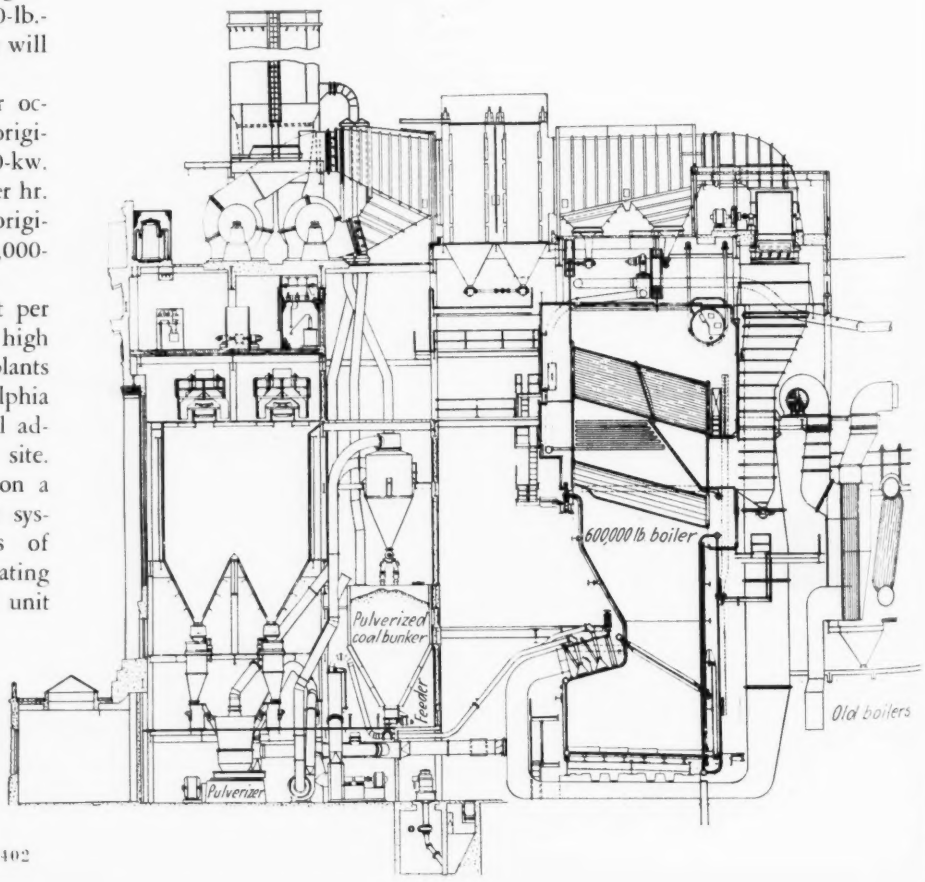
A new unit has recently been placed in operation. It is a Westinghouse, 165,000-kw. at 90% power factor, 1,800-r.p.m., 2-cyl., tandem-compound machine, designed for 400 lb. pressure and 850 deg. at the throttle. Steam is supplied by two 600,000-lb. per hr. pulverized-fuel-fired boilers. They supply sufficient steam for initial operation of the turbine at the present required capacity of 135,000 kw. There is enough reserve boiler capacity in the present plant to make up the additional steam required for full-load operation of the new unit at a sacrifice in economy. Space is available to install a second 165,000-kw. turbine-generator and four more 600,000-lb.-per-hr. boilers, although three will probably be sufficient.

The new turbine-generator occupies the building space originally provided for a 50,000-kw. machine. Two 600,000-lb. per hr. boilers occupy floor space originally intended for four 200,000-lb.-per-hr. boilers.

To secure lowest unit cost per kilowatt, and scarcity and high cost of new sites for steam plants in or adjacent to Philadelphia made it desirable to take full advantage of the Richmond site. Also the unit will operate on a high capacity interconnected system aggregating in excess of 2,000,000 kw. of generating capacity. Although the new unit represents a substantial increase over Philadelphia Electric Company's former generating capacity (approximately 950,000 kw.), its size is justified by the magnitude of the interconnection.

Boiler capacity installed reflects the change in accepted practice since the original design. Instead of 24 lb. of boiler capacity per installed kilowatt, as originally planned, only 9.1 lb. are to be provided for the present unit with its future duplicate, making the average for the ultimate station as now planned 12 lb. per kw. This has been made possible principally as a result of great improvements in boiler and furnace construction and boiler firing with resultant ability to keep units on the line for long periods; and, also, because of inter-connection with other systems which reduces the amount of spare capacity necessary.

As in the case of the turbine, the economics of the situation dictated the selection of the largest feasible boiler unit that would fit into the building, which was originally designed for six boilers on each side of an aisle 24 ft. wide. Column spacing along the width of the boilers was 33 ft. 4 in. with 8 ft. 10 in. spaces between, and the depth was 38 ft. 6 in. The height was approximately 100 ft. It was found that a 600,000-lb. straight-tube, cross-drum, pulverized-coal-fired boiler could be installed in the 33-ft. 4-in. width by



Cross-section through new 600,000-lb.-per-hr. pulverized-fuel-fired boiler

STATION

By E. L. Hopping and F. P. Fairchild***

using the space allotted for the 200,000-lb. companion boiler across the aisle for the coal bunkers and pulverizing equipment. The height was kept within limits by installing dust precipitators and fans above the roof line.

A study of boilers with economizers indicated that for 400-lb. pressure and pulverized-fuel firing, where air for combustion can be highly preheated, there was in this case insufficient improvement in economy to justify the added complication of economizers.

In studying methods of fuel burning for the new unit, pulverized-fuel firing was selected for the following reasons: (1) Lower annual costs made up of fixed charges and operating expense. (2) Possible savings from ability to burn certain cheaper fuels which could not readily be handled on stokers. (3) Adaptability of the pulverized-fuel installation to gas or oil firing. (4) Ability to keep boiler on line for long periods due to parts requiring maintenance being outside of furnace.

Capital expenditures were affected by structural and other changes which had to be made in existing facilities to install either pulverized-fuel or stoker-fired boilers, so that it is impossible to say definitely that the same conclusion with respect to first cost would exist in a new installation not involving alterations. Operating costs were estimated for the type of load which this plant must carry, taking into account its operation on a system having considerable hydro-electric capacity, which somewhat penalized stokers through boiler banking costs. No charge for ash removal was made against stokers, since over a portion of the year this ash may be disposed of at a profit. In case of pulverized-fuel a substantial cost was allowed for removal and disposal of ash from Cottrell precipitators and slag furnaces.

Adaptability of pulverized-fuel boilers for gas or oil firing had a very definite influence on the decision, as in the future it may be desirable to use this flexibility in the new boilers. Burners were purchased with this provision.

Use of bin and feeder interposed between mills and burners was decided on for the following reasons: (1) Closer control of combustion, (2) Greater reliability, (3) Greater flexibility, (4) Lower pulverizing cost, and (5) Safer operation.

Evaluation of these advantages is a difficult matter and the result will vary greatly with local conditions. Our decision does not imply that the storage system can be justified in every installation. For instance, in this case the building could not have been utilized to better advantage had the direct system been used.

Coal is dried in the mill by introducing hot secondary air tempered with room air in sufficient quantities to maintain about 150 deg. at the mill outlet. Use of flue gas instead of air for drying was considered but ruled out because of the danger of corrosion

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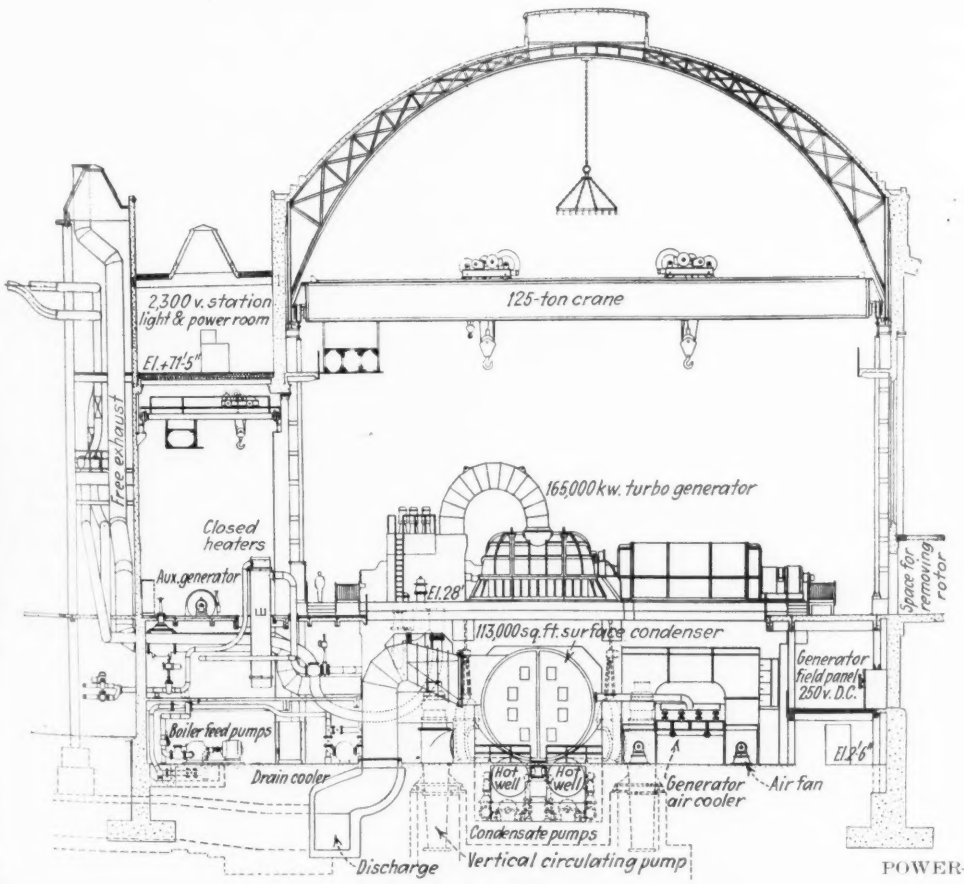
**Power Engineer, United Engineers & Constructors, Inc.



Cross - section through turbine plant showing new 165,000 - kw. tandem-compound unit

and the added complication of mill piping. The entire system, including the fans, is designed for an internal pressure of not less than 50 lb. per sq.in. so that, in case of explosion, gases will vent through an atmospheric relief valve above the collector. All piping is arranged with sufficient slope so that the system will clear itself when the mill is shut down.

In the case of steam temperature, there was no restriction as to interchangeability of boilers, it being possible to use the steam from the old boilers on the new unit by sacrificing some efficiency, or use the steam from the new boilers on the old units by desuperheating. Increasing the temperature did not materially affect the size of the equipment, so that 850 deg., the maximum temperature for which standard equipment could be obtained, provided an economical step.

Superheaters are arranged for straight counterflow of gases and steam, with no provisions for regulation other than can be had by varying the excess combustion air. This was found to be the most economical arrangement considering the first cost and operating charges. Parallel flow for the final superheater loops, although somewhat cheaper due to elimination of special steels, requires more surface and does not result in as flat a temperature characteristic. Two-stage superheating, with desuperheating between stages, proved to be too expensive to be justified, probably due to the fact that with 400-lb. pressure the advantages of maintaining 850 deg. at the throttle is not as great as it is with a higher pressure.

All field piping joints on high-pressure steam, feedwater, blowdown and oil lines, including joints at valves are made by butt-welding the pipe ends without reinforcing straps or sleeves. Steam connections at the main turbine and feed water connections at the pumps, heaters and boilers are flanged. The advantage of welded joints with high-temperature steam is apparent. All welds were in accordance with A.S.M.E. Class I requirements with the exception of X-ray.

Fire hazard from turbine oil was given considerable thought from the beginning of the design. Aroclor is used for turbine governing and is entirely separate from low-pressure bearing oil. Feasibility of this arrangement was completely investigated on one of the company's machines at Delaware Station. As an added safety measure, the turbine oil reservoir, oil coolers and pumps were installed in a special room isolated from the turbine.

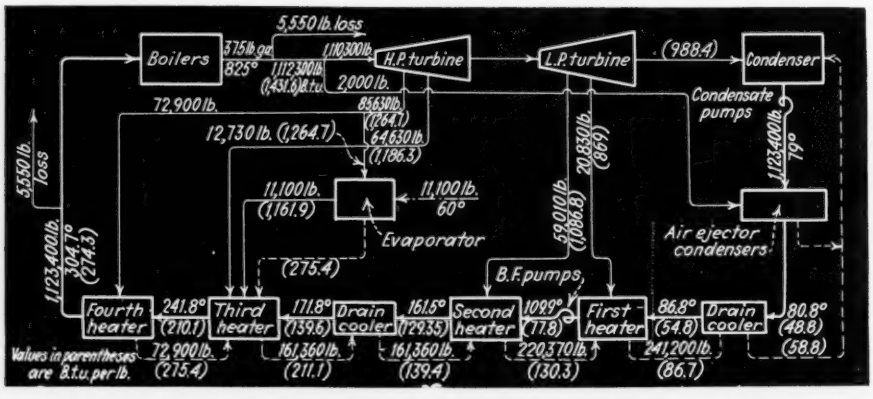
Deaeration of boiler feedwater is accomplished in the condenser, and the entire system beyond the hotwell pumps, including the glands on the pumps, is under pressure. The condenser hotwell is capable, when properly designed, of very effective deaeration, and with this feedwater system, which allows no take-up of oxygen, a great amount of simplification and ease of operation is achieved over former practice where separate open-type deaerators were used. The hotwell is sufficiently large to take the variation in flow. Make-up, when needed, is introduced to the condenser at a point where it is also properly deaerated.

Excess condensate is discharged to the storage tanks after passing the hotwell pump. Essentially the variable-speed hotwell pump is a part of the constant-speed boiler feed pump, since output from the latter is controlled through automatic regulation of hotwell pump speed.

Boiler feed pressure regulation is accomplished by a control which primarily varies the speed of the hotwell pump through hydraulic couplings with the finer adjustments made by throttling the discharge of the boiler feed pump. The new feed pumps discharge into a header common to the other pumps of the station and regulation of the amount of water handled by the new unit pumps is accomplished by readjustment of the feedwater pressure regulator setting from hotwell level. In this way the new pumps take care of the new unit condensate only, leaving the old pumps to do the pressure regulating. However, if the old pumps fail, the new pumps will regulate boiler feed pressure at a slightly lower level. If the new pumps fail, the old pumps will feed the boilers, thus making an existing steam-driven pump operative on the new boilers and obviating the necessity of an additional steam pump.

A compressed-air-operated combustion control was installed, which regulates forced and induced draft and fuel supply from steam pressure with readjustment of forced and induced draft from fuel-air ratio and forced draft only from furnace draft. The forced and induced drafts are regulated by varying the speed of the fans through hydraulic couplings without the help of dampers. To make possible quick changes of speed on the fans a positive oil pump replaces the usual gravity tank and weir arrangement for supplying oil to the coupling. The pump runs continually and is valved so that it may pump oil to or from the coupling circuit with considerable head, resulting in much faster response of the couplings to speed change impulses.

The addition to Richmond was designed and constructed by United Engineers & Constructors Inc., in conjunction with the engineers of Philadelphia Electric Company.

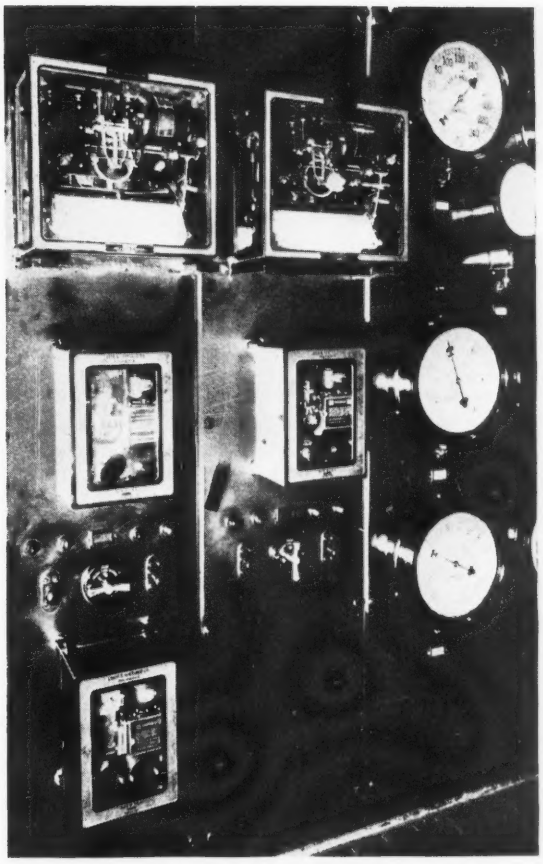


Turbine heat balance diagram for 130,000-kw. load and 1-in. back pressure

D.C. TO A.C.

AT CONSTANT FREQUENCY

In College of the City of New York power plant, three steam-engine-driven d.c. generators furnish main power supply. A.C. is provided by two 100-kva. motor generators



Automatic frequency control and recorders for the two d.c. motor generators

IN 1931, the College of the City of New York, 139th St. and Convent Ave., New York, N. Y., obtained an appropriation to modernize its power plant. Specifications included three Corliss engines directly connected to 3-wire direct-current generators. These specifications included unusual requirements on operating efficiency, overload capacity, voltage recovery and ability to feed lighting circuits without producing light flicker under shock load.

The new power plant now comprises two 250-kw. General Electric 2-wire generators, each driven by a Harrisburg 4-valve engine and a similar 100-kw. unit. Each generator is provided with balancing coils for 3-wire 250- and 125-volt operation. Two Westinghouse motor-generator sets, each comprising a 125-hp. direct-current motor driving a 100-kva., 3-phase generator, supply power to the extensive college electrical laboratories. (When the generating units were being tested, full output of one 250-kw. machine was absorbed by laboratory equipment.)

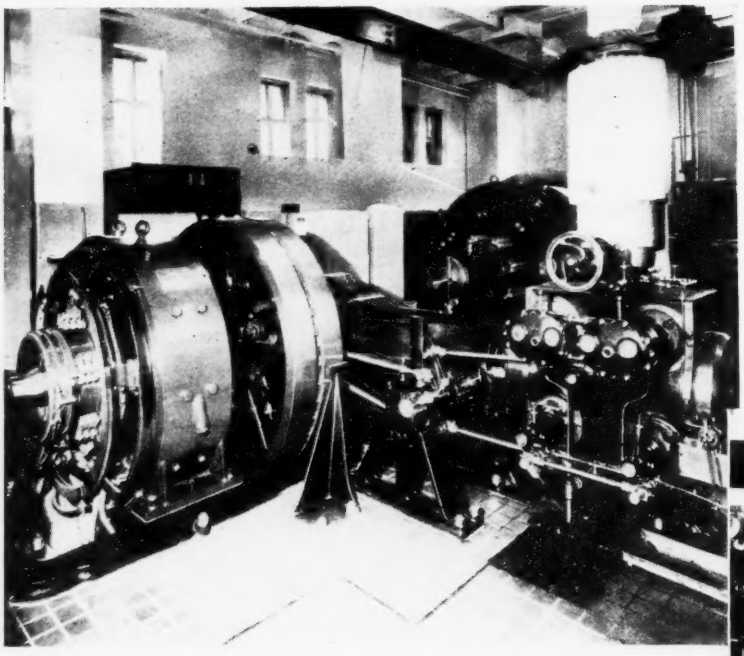
Because of the heavy loads taken or dropped suddenly by the laboratories, light flicker was a difficult problem. This was solved with flicker compensators, voltage stabilizing devices used where separate lighting and power circuits are fed jointly. Each compensator, one per generator, comprises a 3-winding current transformer, one winding connecting into the power circuit, another in the lighting circuit and a third is connected in the generator shunt-field circuit.

Transformer windings in series with lighting circuits, and shunt-field windings, are so connected that induced voltage due to a sudden load increase boosts applied voltage. When a block of power load is suddenly dropped and generator voltage tends to rise, the secondary-winding voltages of the flicker compensators oppose this rise. By proper proportioning of flicker compensator windings, lighting circuit voltage can be maintained within flickerless limits under even sudden 50% load changes.

There are no power or lighting switches on the switchboard. Each power or lighting circuit is protected by an overload trip-free circuit breaker, which also acts as the circuit switch.

As previously mentioned, alternating current for the laboratories is provided by two motor-generator sets. A.C. bus bars are arranged so that either set can be operated independently and connected to any or all of the three feeders, or sets may be paralleled on the buses with various feeder combinations. Normally one unit supplies the balanced 3-phase load while the other takes the remainder, which may be anything that might interfere with maintaining a balanced 3-phase system.

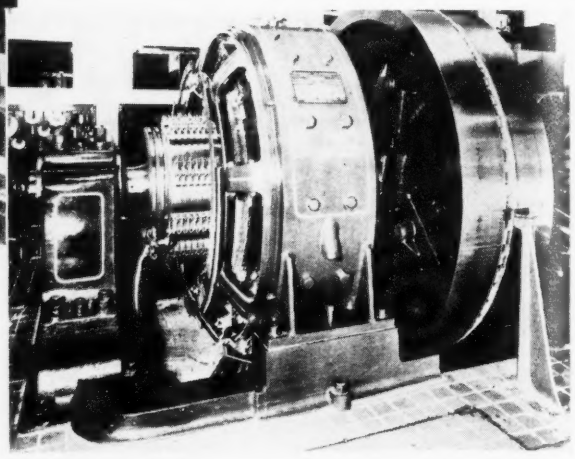
For laboratory purposes it is desirable that frequency be held constant at 60 cycles. Because load changes cause a d.c. motor to change speed, the frequency of an a.c. generator driven by it may vary over a wide range.

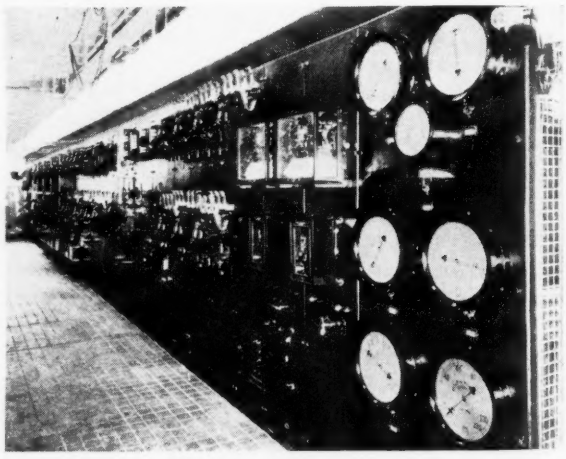


Left—Power plant has two 250-kw. and one 100-kw. 3-wire d.c. generators

Below—One of the two 250-kw., 250-volt d.c. generators

Bottom—On this main switchboard all automatic circuit breakers serve as disconnect switches also





This difficulty has been solved by installing a Leeds & Northrup automatic frequency control on each of the motor-generators along with frequency recorders.

For maintaining constant frequency, the generator's motor-field current is varied automatically to change speed to compensate for load swings on the a.c. end. The proportional-step type control system used consists essentially of a frequency controller for each unit, operating a motor-driven rheostat controlling main field current to the motor of its motor-generator set. When the units are operated in parallel on the bus, a current controller distributes current between units.

On each frequency controller the frequency-sentitive element is a null-type impedance bridge, utilizing a galvanometer to detect bridge unbalance. Direction of galvanometer deflection is determined by whether frequency is high or low. This deflection is picked up by the controller mechanism, which sends correcting impulses to the motor-driven rheostat to vary driving-motor speed until the frequency of its alternator is correct. Controller sensitivity is such that it will detect frequency variations of 0.005 of a cycle from the control point.

When frequency is high, the deflection of the galvanometer sends an impulse that causes the field-rheostat motor to reduce main-motor shunt-field circuit resistance and slow down the motor-generator set. When the frequency falls below normal, the galvanometer sends an impulse to increase main motor speed. This is exactly the procedure that an operator might follow, but the automatic frequency controller is sensitive to frequency variations on the order of 0.005 of a cycle and therefore starts to correct before the deviation in frequency can be detected by an operator.

When frequency deviates from normal it may be brought back by either varying the number of impulses in a given time or by changing the duration of a given impulse. The latter method has proved more satisfactory. A feature of this proportional-step frequency controller is the design of the cams and contact mechanism which make the impulse duration sent to the speed-control motor proportional to the frequency deviation from the control setting. The greater the frequency deviation from the control setting, the longer the correcting impulse. As frequency approaches normal the correcting impulse is correspondingly decreased.

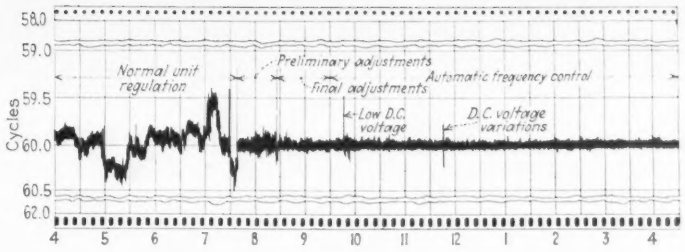
Galvanometer deflections therefore are proportional to the bridge unbalance, or frequency deviation, and the length of the correcting impulse sent to the rheostat is proportional to galvanometer deflection. Change in field current of the driving motor of the motor-gen-

erator set is, therefore, proportional to the frequency deviation. This prevents overshooting or hunting and, to a large extent, accounts for the close instantaneous frequency regulation obtained. On each controller the control point is adjustable so that frequency can be maintained at different values on different busses, if desired, for experimental work.

Each frequency controller operates the motor-driven rheostat on its unit through contactors arranged for dynamic braking of the rheostat motor. Limit switches prevent overtravel of the face-plate-type rheostat. Resistance per stud over the no-load to full-load range of the unit is tapered to match the speed-load curve of the motor of the motor-generator set. The smallest step between studs gives an approximate speed change of 0.02 cycle.

When the units are paralleled on the bus, load is divided between units on the basis of total current, both in phase and reactive. Due to the nature of the load, the power factor is extremely variable and it was desired to equalize heating on the two units. Since this is a function of the total current, this basis was used for load distribution.

Complete protective equipment, including alternating-current and direct-current no-voltage relays and frequency limits, is provided. Trip and reset switches remove the control from service or place it in operation



Frequency record without and with automatic control

and signal lights indicate control-circuit condition. Graphic frequency recorders of the impedance-bridge type produce a record of the regulations on each unit. The open scale of 58 to 62 cycles permits direct reading of the smallest chart division of 0.05 cycle.

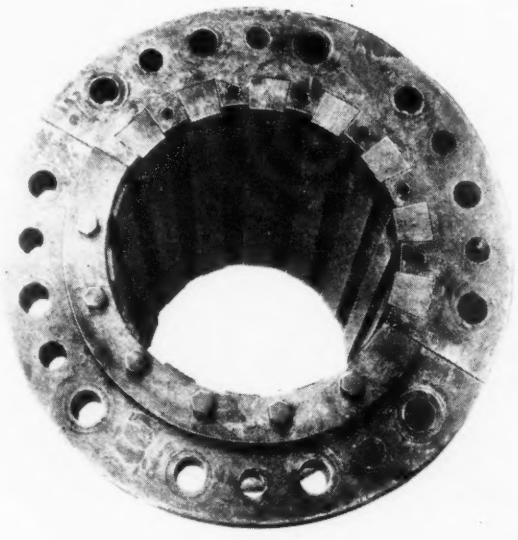
A comparison between normal unit regulation and automatic control is shown in the frequency record of an actual test run. Frequency is normally held well within plus or minus 0.05 cycle under automatic control.

Prof. H. Baum, head of the Department of Electrical Engineering, and his associate, Prof. M. Henry, assisted greatly in preparation of this article. Operation of the power plant is in charge of Edward Bell, chief engineer.

Micarta-Lined Waterwheel Bearings

LIGNUM vitae is a natural tropical wood used for more than 100 years to line mill, waterwheel and steamship stern bearings. The natural product can now be replaced by a synthetic one called Micarta. The grade used for bearings is built up from laminations of fabric impregnated with a phenolic compound similar to resin. Stacks of these laminations are subjected to heat and pressure to form a dense, strong, homogenous material.

Guide bearing for a Niagara Falls waterwheel



By V. Enz

Westinghouse Electric & Manufacturing Co.
Engineer,

Micarta can be machined as readily as lignum vitae. When used for bearings it comes in blocks 3 ft. square up to 5.5 in. thick. These blocks can be sawed and machined to fit into the old housings for wooden bearings. Water passing through the bearing lubricates and cools it and, in addition, washes away the mud and grit so that they are not allowed to lodge on the working surfaces. Several of the bearings are now in use as guide bearing on waterwheels.

Micarta is rolled in tubes for use on small-diameter shafts which require a bushing. Fluted grooves are machined on the insides of these tubes to allow the water to circulate. There are bushings of this type installed on a 1.5-in. stainless-steel shaft operating at 1,800 r.p.m. on a 38-ft. cruiser. These bearings have been in operation for over a year with both shaft and bearings still in fine condition.

Micarta is stronger than lignum vitae and will therefore support greater loads, is resistant to water and weak acids, and is not impaired by age. When out of water lignum vitae is likely to split or crack while Micarta does not. Although the latter has a higher initial cost, it has a longer life under the same conditions.

GREASES—

WHAT...WHERE...HOW...WHY

By James I. Clower
Asst. Prof. of Machine Design,
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GREASE, strictly speaking, is a lubricant consisting of a soap base and a mineral oil. In the broader sense of the word it includes also products prepared by thickening a mineral oil with such solids as graphite, talc, mica, chalk, soapstone, sulphur, rosin, etc., as well as very heavy, dark residuum oils blended with lighter petroleum oils or compounded with fatty oils of various kinds.

Greases are variously classified as in the second column from the left in the table. From the standpoint of manufacturing, however, they may be divided into three general classes: cooked or boiled, cold sett, and residuum greases.

Cooked or Boiled Greases

Many modifications are necessary in order to make a particular kind of cooked grease. The procedure, however, is essentially the same for all sorts. Preparation of the soap base follows closely the general methods of preparing soaps, and involves hot saponification of fat with alkali. The usual practice is to add a sufficient quantity of mineral oil at the time of saponification to produce an approximately neutral soap. The main portion of the mineral oil is then added and the whole constantly stirred until free of lumps and homogeneous. It may then be run directly into the containers. If an especially smooth, uniform consistency is desired, the grease is strained through fine gauze or passed through a grinding mill to remove or crush any remaining lumps.

A representative procedure for making lime-base grease is to charge a fired or steam-heated kettle, provided with a mechanical stirrer, with the proper amount of fat or fatty acid and raise the temperature to about 180 deg. F. Milk of lime is then added in sufficient quantity to saponify the fat, and the whole stirred and boiled at a temperature of approximately 300 deg. F. and usually at a pressure of 60 to 90 lb., until saponification is complete. A small portion of the mineral oil, (usually about 3%) at a temperature of about 190 deg. F. is slowly stirred into the soap base. The remainder of the mineral oil is then added cold until the desired consistency is obtained. A small, carefully-controlled amount of water is added in order to prevent the soap and mineral oil from separating, and the whole cooled below 210 deg. F. (The water acts as a binding agent and is an essential part of all lime-base greases.) The batch is then stirred for about half an hour longer, the still hot contents of the kettle then run off through a cooling pipe, if required, are strained or milled and then run into the containers.

Soda-base greases are made similarly to lime-base greases, caustic soda being substituted for the lime in preparing the soap base. During preparation of the soap, practically all of the water is boiled from it and the fats. This boiling off of the water is known as "dehydration" or "cooking dry." After the soap has been formed, the mineral oil is added, and at the temperature existing in the kettle, a homogeneous mixture is readily secured without addition of water or any other binding agent. This, together with the fact that soda breaks down in the presence of water, constitutes the important differences between lime-base and soda-base greases.

Aluminum-base, mixed-base, and other special-base greases are all prepared in much the same manner as lime-base and soda-base products, substituting, of

GREASES—Classification, Composition and Uses

Classification	Class Name	Composition: Alkali	Composition: Fats	Composition: Mineral Oil	Recommendations and Remarks
According to soap base	Lime-base	Calcium hydroxide (Slacked lime) $Ca(OH)_2$	Horse, hog, bone, wool fats; lard, fish, rape, castor, rosin, palm, foots oils; beef and mutton tallows; esters of palmitic, oleic stearic acids	25 to 28 deg. A.P.I. paraffin oils; light-pale, heavy-pale, heavy - red spindle oils; and cylinder oils.	General-purpose greases, widely used in compression grease cups, gear boxes, etc., in industrial plants where operating temperatures are below 175 deg. F., and not subject to high speeds and churning. Not suitable for ball and roller bearings, centrifugal force incident to high speeds tends to throw out water content and causes separation of soap and mineral oil. They resist washing action of water.
	Sodium-base	Sodium hydroxide (Caustic soda) NaOH	Same as for lime-base greases	Same as for lime-base greases	Suitable for high temperatures and speeds as they do not contain water as a binder. Not suitable for use in water; readily emulsifying with it. Recommended for ball and roller bearings, plain bearings operating at high temperatures, in centralized pressure lubrication systems where light lubricant is required and a non-separating product is essential to avoid clogging of supply piping.
	Mixed-base	Calcium hydroxide + sodium hydroxide, and sodium hydroxide + aluminum hydroxide	Same as for lime-base greases	Same as for lime-base greases	Used where conditions do not permit using lime-base or soda-base greases, such as high-speed bearings in the presence of water. A soda-base grease is required for the high centrifugal force incident to high speed, and a lime-base grease is required to resist washing action of water. Mixed-base product combines to a certain degree characteristics of the lime and the soda greases.
	Aluminum-base	Aluminum hydroxide dissolved in a small quantity of sodium hydroxide	Same as for lime-base greases	Same as for lime-base greases	Combine some advantages of lime- and soda-base greases. Are water repellent; withstand high temperatures; do not separate when agitated or in centralized pressure greasing systems. Used for wide variety of services, where operating temperatures and speeds are high, as in aviation and automobile practice.

Classification	Class Name	Composition: Alkali	Composition: Fats	Composition: Mineral Oil	Recommendations and Remarks
According to manufacturing methods	Cooked or boiled	Same as for lime-soda, mixed and aluminum-base greases	Same as for lime-base grease	Same as for lime-base grease	See Lime-, soda-, mixed-, and aluminum-base greases above.
	Cold sett	Calcium hydroxide	Rosin acid	Usually dark lubricating oils	Used to lubricate rough machinery in steel mills, coal mines and wire ropes, chains, switches, etc. Never use on brass bearings; they cause corrosion.
	Residuum	None	Generally none	Dark lubricating oils and cylinder stock	Sometimes an animal or vegetable oil is added as well as tar, rosin oils, etc. Very adhesive and tacky. Used for lubricating chains, cables, open gears, etc.; generally applied hot by swab or brush.
According to consistency	Very hard No. 5	Generally sodium hydroxide	Same as for lime-base greases	Dark lub. oils and cyl. stock	High melting point, used for high-temperatures such as paper dryers, cement-mill kilns, tube mills, coolers, ball and rod mills, calenders, etc.
	Hard No. 4	Sodium hydroxide calcium hydroxide	Same as for lime-base greases	Various spindle and lub. oils	For services similar to very hard greases, where temperatures are not extreme, such as stone crushers, coal pulverizers, valve gears, etc.
	Medium No. 3	Sodium hydroxide calcium hydroxide aluminum hydroxide	Same as for lime-base greases	Various spindle and lub. oils	Used for ball and roller bearings, high- and low-speed governors, gear housings of machine tools, air tools, general grease-cup purposes, etc.
	Soft No. 2	Same as No. 3	Same as for lime-base greases	Paraffin oils and spindle oils	Used for line-shaft bearings, ball and roller bearings, gear boxes, general grease-cup purposes. Suitable for grease-guns.
	Very soft No. 1.	Same as No. 3	Same as for lime-base greases	Paraffin oils and spindle oils	For conditions similar to those for which soft greases are recommended, but where temperatures are lower and speeds higher.
	Fluid No. 0	Same as No. 3	Same as for lime-base greases	Paraffin oils and spindle oils	Used for air tools, chain drives, textile and wood-working machinery, speed reducers, cranes, circulating systems of gyratory rock crushers, etc.
According to commercial uses	Cup greases	Generally calcium hydroxide	Same as for lime-base greases	Same as for lime-base greases	Usually lime-base greases comprising 80 to 90% mineral oil and 10 to 20% of saponified fat, preferably clarified beef tallow. Water generally present from traces up to 1%. A small amount of emulsified water, usually less than 0.4%, added to prevent separation of soap and mineral oil and give proper consistency. Melting point from 120 to 200 deg. F., depending on the soap content. Not considered highest type of lime-base grease.
	White cup greases	Generally calcium hydroxide	Selected fats. Usually mutton tallow	Light and heavy pale spindle oils	Usually made of selected fats, such as mutton tallow, very little mineral oil. Contains considerable unsaponified fat, are highest in lubricating value and price of cup greases. Melting point is low, from 100 to 160 deg. F. Certain white greases contain pulverized mica, sold as mica grease. Used in textile mills, canning plants, dairies, bakeries, etc.
	Fiber and sponge greases	Sodium hydroxide	Same as for lime-base greases	Same as for lime-base greases	Called fiber or sponge greases because of their peculiar fibrous or granular structure. Melting point is high, 200 to 400 deg. F. Cannot be used in presence of water, because they readily emulsify with it and easily wash from bearing surfaces. If of good quality, can be melted and cooled again without altering their consistency. Contain no filler of any kind. Especially suitable for lubrication of ball and roller bearings.
	Ball- and roller bearing greases	Calcium hydroxide sodium hydroxide aluminum hydroxide aluminum stearate lead oleate, etc.	Same as for lime-base greases	Paraffin oils and spindle oils	Soft greases, composed of petroleum jelly, or mixtures of this with mineral oil, or soft cup greases composed of mineral oil thickened with lime, soda or aluminum soaps. Generally soda and aluminum-soap greases are superior to lime-base greases for ball and roller-bearings, since these are practically free from water and are disposed to separate at high speeds. Essential features of such a grease are that it be neutral or slightly alkaline and free of water.
	Petroleum greases	Calcium, sodium and aluminum hydroxide, and aluminum stearate, and oleate, and lead oleate, etc.	Same as for lime-base greases	Same as for lime-base greases	Sometimes called solidified oils; made cold by dissolving soaps in mineral oil. Soda, aluminum and lead soaps are used. Aluminum-oleate and aluminum stearate (a mixture of stearate and palmitate) used. Mineral oils thickened with aluminum soap have non-homogeneous nature; viscosity is unstable and the oil is of a slimy nature, forming threads when dropped. In water and steam the soap settles out and may clog oil grooves, piping, etc. Mineral castor oil is made by dissolving from 2 to 5% of aluminum soap in a light paraffin oil. These so-called greases are used in cotton mills and places where non-splash lubricants are necessary.
	Graphite greases	Generally calcium hydroxide	Same as for lime-base greases	Same as for lime-base greases	Usually cup greases to which has been added from 5 to 20% flake graphite. Widely used in steel mills, cement plants, quarries, etc.
	Gear greases	Sodium, calcium, aluminum hydroxide or none	Same as for lime-base grease or none	Heavy lub. oils; Dark lub. oils, and cyl. stock	Gear greases may be residuum, lime-, soda-, rosin-base. Frequently contain dark cylinder oil as a softening ingredient. Have high melting point generally. Possess good adhesive properties and absorb shock loads.
	Axle greases	Calcium hydroxide	Generally rosin acid	Dark lub. oils cylinder stock	Usually made from lime and rosin oil, with or without addition of mineral oils. Lime combines with rosin acid, forming soap which thickens the oil. Usually more lime used than necessary to combine with rosin acid, excess remaining as filler. Mica, talc, soapstone, etc., frequently used as fillers. Suitable for rough service, such as cast-iron bearings of farm machinery, etc.
	Wool and yarn greases	Generally calcium hydroxide	Same as for lime-base greases or none	Same as for lime-base greases	Cup greases containing short lengths of woolen or cotton yarn. Strands should be from 1.5 to 2.5 in. long. Longer strands become entangled and make it difficult to divide the grease. Used on crane, mine-car, and certain types of heavy-duty electric-motor bearings.
	Mine-car greases	Calcium hydroxide	Generally rosin acid	Dark lub. oils and cyl. stock	Cheap, black rosin greases, generally containing large percentage of water and filler. Used on mine-car bearings, switches and tracks.
	Wire-rope greases	Calcium hydroxide or none	Generally rosin acid	Dark lubricating oils and cylinder stock	Generally cheap greases of either rosin-base or residuum type. Generally not corrosive, very tacky and adhesive, often contain wool pitch, stearing pitch, etc.
	Launching greases	Generally none	Generally mixed fats	Dark lub. oils and cyl. stock	Tallow substitutes, composed of mixed fats and possibly some soap, are cheap, and not suitable for lubricating bearings.
	Hydraulic greases	Calcium hydroxide or none	Same as lime-base greases or none	Dark lub. oils and cyl. stock	Often of rosin-base or residuum type. Black, very adhesive, strong resistance to washing by water, widely used where water is present.
	Hot-neck greases	Sodium hydroxide, calcium hydroxide, or none	Same as for lime-base greases	Dark lubricating oils and cylinder stock	Very hard, of No. 5 consistency, made from heavy residues such as wool pitch, stearing pitch, petroleum pitch, heavy asphaltic-base mineral oils, thickened with soap or rosin grease and containing talc or graphite.
	Block or brick greases	Sodium hydroxide	Same as for lime-base greases	Dark lubricating oils and cylinder stock	Very hard, all water has been boiled out. Often supplied in blocks, shaped to cavities of bearings. Used in steel mills on roll necks and heavy duty machinery subject to high temperatures and shock loads.
	Locomotive driving-box greases	Sodium hydroxide	Generally tallow or palm oil	Heavy lubricating oils and cylinder stock	Emulsified mixtures of oil, fat, soap and water, such as tallow, palm oil and mineral oil. Soda-base soap containing no free water.
	Anti-rust greases	Generally none	Generally none	Generally heavy lubricating oils	Do not usually contain a soap thickener, but composed of neutral refined petroleum jelly and heavy mineral oil. Not strictly a grease. Widely used to rust-proof razor blades, needles, hand tools, instruments, etc.
	Calender greases	Sodium hydroxide	Same as for lime-base greases	Dark lub. oils and cyl. stock	High-melting-point soda-base greases, similar to block greases. Sometimes packed in canvas bags to apply as pads to calender-roll bearings.
	Cold-neck greases	Sodium hydroxide calcium hydroxide or none	Same as for lime-base greases	Dark lub. oils and cyl. stock	May be block soda-base greases made with black viscous oils or they may be rosin greases made with black residuum oils. Variety of grease used for this purpose.
	Locomotive rod-pin greases	Sodium hydroxide	Generally tallow or palm oil	Dark lub. oils and cyl. stock	Very hard greases usually, of soda-base type, made in round sticks known as grease sticks.

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course, the corresponding alkalies for the lime and soda.

Cold-sett greases are made by mixing while cold, or at a temperature less than 150 deg. F., mineral oil, rosin oil and sett, which is an emulsion containing light mineral oil, water, hydrated lime, and a small quantity of rosin oil. The rosin oil reacts with the lime to form a small quantity of rosin soap, which stabilizes the emulsion. The mixture solidifies in a few minutes, and the resultant product is insoluble in water, hence is unaffected by it. Cold-sett grease has a higher melting point than lime-base grease.

So-called residuum greases are prepared in two ways: by simply blending heavy, dark oils with the residuum or bottoms from crude-oil stills; and by mixing various fats with a blend of residuum and heavy dark oil. Strictly speaking, these two products are not grease, the first being simply a blended oil, while the second is a compounded one. Both types are made in a wide range of consistencies varying from products that flow freely at ordinary temperatures to those so viscous that they must be heated before they can be applied with a paddle or swab.

It is not to be assumed that anyone supplied with the necessary equipment and material can make a good grease, for such is not the case. Making grease is an art, depending not only on formulas, ingredients and equipment but also very much on the skill of the maker. Two greases may be made according to the same formula but they may vary widely in appearance and lubricating properties due to methods of mixing the ingredients and finishing the products.

Early machines could be lubricated with comparatively few and simple greases because speed, load and temperature requirements were easily satisfied. Today, however, operating conditions are quite different. Many modern machines are composed of several highly specialized mechanisms; some are very complicated—all exact in their lubrication requirements. This development in the mechanical field has brought about many highly specialized greases, each especially made to fulfill individual requirements. Consequently, there are greases to meet high temperatures or sub-zero frigidity, to repel water and chemicals, to lubricate without spattering or staining, to be odorless and tasteless, to withstand high or low speeds, and heavy or light loads. Some not only have to meet the requirements of one of these conditions, but frequently a combination of two or more of them; hence the number of greases available runs into the hundreds.

They are made in all sorts of forms; some contain hair or strands of wool or yarn. They may be almost any color, ranging from pure white to black. In consistency they vary from extra hard greases, which must be cut with a knife, to liquid greases which may be easily poured from a container. There are "cooling sticks," "grease blocks," "grease rats" and many other forms. Cooling sticks are about 8 in. long and are used for relieving over-heated journals, especially "hot-boxes" of locomotives and cars. Grease blocks are extensively used on the hot-necks of rolling mills. Grease rats are long intertwined strands of grease-soaked wool used to wrap around open bearings.

Other special greases contain abrasive materials. These are block greases used to polish aluminum wares, and oddly enough the abrasive used is aluminum oxide. Another special grease contains phenydichlorarsine, a highly poisonous substance. This grease is used for treating wood and destroys termites.

The accompanying table gives the more common names applied to greases. Column 3 from the left gives their compositions, column 4 shows the general type of service for which they are best suited. Obviously, the table is not complete, but covers only the most used greases.

A second article will discuss grease versus oil lubrication and the application of grease.

IMPROVE COMMUTATION FOR BETTER OPERATION

By C. Lynn

Westinghouse Electric & Mfg. Co.

ON LARGE direct-current machines and synchronous converters, the permissible output without excessive maintenance is limited by performance of the current-collecting parts. Increased output is possible from many old machines by modernizing their current collectors. In many instances, this can be done at considerably less cost than that of installing new equipment corresponding to the increase of capacity, and increased space is not required.

Much has been done during the last five to ten years to improve commutators, collectors and brush rigging. Equipment for building and testing these parts has been made, so that now they can be purchased with assurance that their performance will be highly satisfactory without running-in or seasoning in service.

In older commutator designs it was not recognized that on high-speed commutators a bar-to-bar roughness of only 0.0001 in. would give trouble. Therefore, the structures were not provided with means to maintain highly accurate commutator-surface conditions. Larger-size commutators were usually of a three-vee design, Fig. 1, which, though holding the long bars in place, did not provide adequate support to hold them within the tolerance required.

Vee-ring commutators of modern design are always

of a two-vee type construction. This type permits the bars to be held adequately throughout their length. One vee ring is made part of the commutator spider, while the free vee ring is centered by a thin circular steel disk. This centering disk is so proportioned that it can bend while still keeping the vee ring centered, as the commutator bars lengthen or shorten with temperature changes.

A heavy cross-section of vee ring eliminates distortion or twisting as stresses of expansion are placed on it. Fig. 2 shows a commutator with this type of construction. Commutators for large current ratings generally have cooling fins at the front ends of the bars. Heat rapidly conducted along the commutator bars is dissipated into the air surrounding these fins.

Adequate brush rigging and suitable brushes are equally important to a good commutator. A good brush-holder should be of a short and sturdy construction. The inside of the brush box should be accurately machined to dimensions to give free movement of the brushes but not permit them to chatter or vibrate in their holders. Brushes should incline approximately 30 deg. in a direction against rotation. A means of easily adjusting brush pressure should be provided. Two brushes in a single box, with a partition between them give improved performance.

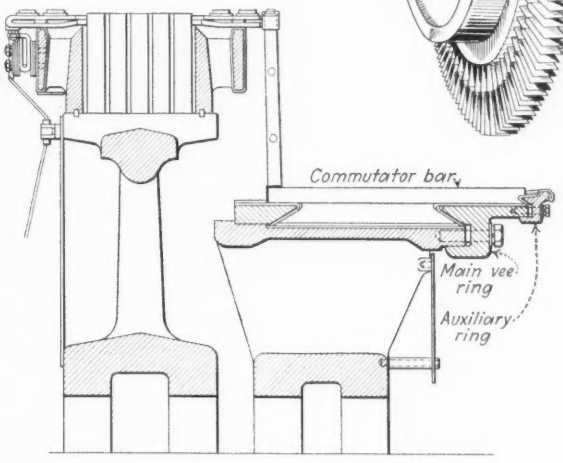

Fig. 1 (Right)—Section of three-vee types of commutator construction

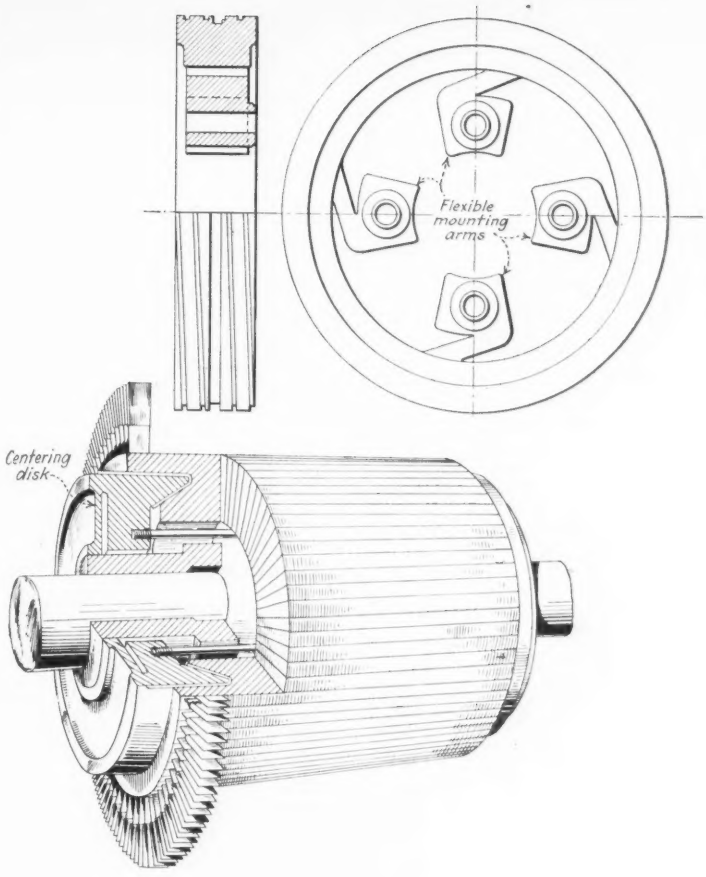

Fig. 2 (Above)—Medium-size modern-design commutator

Fig. 3 (Top) — Modern, heavy-duty type, spirally grooved collector ring with flexible mounting arms

On synchronous converters, alternating-current brush and collector ring maintenance is an appreciable percentage of the total. Spiral grooving of the collector rings reduces the air pressure under the brushes in normal operation, permitting more intimate contact between brushes and rings. The spiral groove relieves a changing portion of the brush face from carrying current, for a short period, as the ring revolves. This reduces local hot spots and causes a more even distribution of current over the brush face and between the brushes themselves, with resulting longer brush and ring life. On commutators where considerable roughness occurs, spiral grooving has been found to be of considerable benefit.

Design of collector rings has also been improved by making all arms the same length and supporting them flexibly. Thus, expansion of the arms will not distort the ring radially. Cross-section of rings has been materially increased. Large rings are divided at the surface to provide two collecting paths, Fig. 3. A new alloy, having substantially the same conductivity as hard-drawn copper and from 30 to 50% greater hardness, materially improves ring performance and wearing qualities.

When revamping old machines, it is usually possible to replace the commutator with one of modern design by simply unsoldering the old necks, placing the commutator and resoldering the necks. In most cases, this requires no additional equipment other than brush-holders and brushes and adapters suitable for mounting the new brush-holders on the existing bracket. Large-size modern collector rings with flexible arms can usually be made for mounting on the old ring supports. Simple adapters allow using modern alternating-current brush-holders on old supports. Frequently the cost for new current collecting parts will be more than paid for by the savings in maintenance and longer brush life obtained. Output and efficiency will be increased and maintenance reduced.

CHEAPER POWER WITH THE

Superimposing a high-pressure plant on an existing low-pressure unit may cut fuel costs 25% and give needed new capacity

FUEL cost of power in old plants can often be cut in half by a bold, though conservative, scrapping and replacement policy which takes advantage of the development of engineering. In newer plants the possibilities of improvement are somewhat reduced for the efficiency level is much higher. When the initial pressure, however, is low, a reduction in fuel cost of 25% is often possible by taking advantage of higher pressures and temperatures now in good use. If at the same time an increase in plant capacity is desired, the high-pressure plant may be superimposed on the old one with a considerable improvement in performance coupled with an increase in capacity rating. High-pressure turbines so used are called "topping turbines."

In applying a topping turbine to an old plant operating in the lower-pressure range, for instance at 150 lb. pressure, the old boiler equipment is discarded, and new boilers and a new non-condensing turbine-generator which discharges its steam into the inlet of the old turbine are installed. The result is a high-pressure cross-compound unit of increased thermal efficiency and of considerably greater capacity. The proposition does not change when there are several low-pressure turbines in the plant—the new boiler unit and the non-condensing turbine may be arranged to serve all.

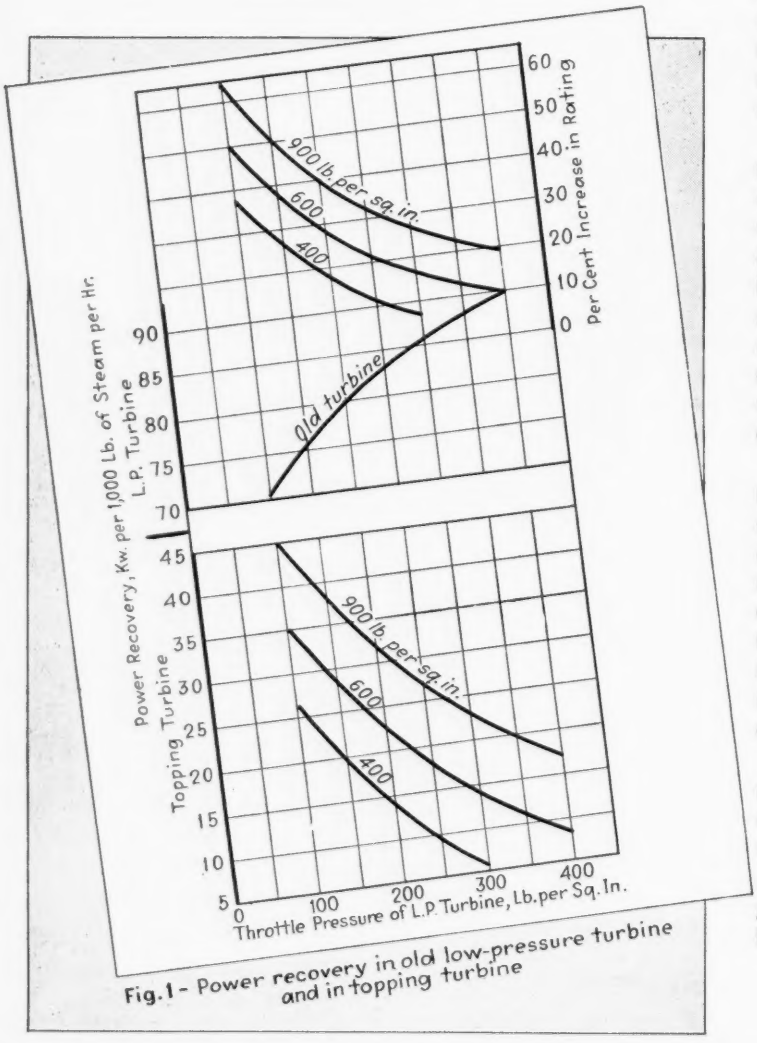
Power Recovery, Kw. per 1,000 Lb. of Steam per Hr.
L.P. Turbine
Topping Turbine
Per Cent Increase in Rating
900 lb. per sq. in.
600
400
Old turbine
Throttle Pressure of L.P. Turbine, Lb. per Sq. In.

Fig. 1 - Power recovery in old low-pressure turbine and in topping turbine

To show the increase in capacity possible with the "topping turbine," the curves of Fig. 1 have been prepared. The middle curve indicates the power obtained from 1,000 lb. of steam expanded through a turbine with an efficiency of 75% at the generator terminals. Initial superheat is taken at 100 deg. Throttle pressures range from 100 to 400 lb. per sq.in., and vacuum is 28 in. This curve by itself suggests the advantage of higher pressures, but not quite accurately, as, with comparable designs, the efficiency of a 400-lb. turbine is less than that of a 100-lb. unit. A constant efficiency (75%) was taken for simplicity.

The lower curves of Fig. I show the *additional* power that can be obtained by first expanding the same amount of steam through a non-condensing turbine with throttle pressures of 400, 600 or 900 lb. per sq.in. The initial superheat is taken at varying values such that the superheat at the inlet of the low-pressure turbine is still 100 deg. so that the performance of the original low-pressure unit is unchanged. Again for reasons of simplicity a constant efficiency is taken—this time 70%. The three curves at the top of Fig. I show the increase in power developed, which in the extreme case shown is 63.5%.

Fig. 2 supplements Fig. 1. The middle curve shows the B.t.u. rate of the original unit. The lower three curves show the B.t.u. rate of the combined units, while the improvement in performance is summarized in the three curves at the top. These B.t.u. rates are based in every case on the condensate being returned at 100 deg. Taken together, both sets of curves (Fig. 1 and Fig. 2) show increases in capacity up to 63.5% coupled with decreases in fuel consumption per kilowatt up to 30.5% obtained by a comparatively small outlay for new equipment.

Several variations of the "topping turbine" application are in common use. The simplest and most efficient over the entire load range is with the non-condensing turbine as the high-pressure element of a cross-compound unit (or units). Governing is then done entirely by the high-pressure governor. An objection to this method from the viewpoint of the industrial plant is that the cross-over pressure varies with the load, thereby rendering useless all the old steam-driven equipment except the turbine-generators.

The common arrangement in industrial plants is to maintain the original boiler pressure at the non-condensing turbine exhaust. Then the auxiliaries, compressors and other old plant equipment are unchanged. A back-pressure regulator on the high-pressure unit is a great help in operation, but pressure can be maintained by manipulating the load. In some cases, the old boilers

"TOPPING TURBINE"

By N. D. Gove
Westinghouse Electric & Mfg. Co.

are retained in service and only part of the steam is generated at high pressure. Then the low-pressure boilers are operated at varying load to maintain the pressure while the high-pressure element (on account of its greater efficiency) is kept well loaded.

Another arrangement used in industrial plants combines the "topping turbine" with by-product power generation from process steam. In this application the high-pressure turbine is a bleeder unit with steam extracted at the old boiler pressure under automatic bleeder control for use in other prime movers and exhausted to process lines to meet heating demands.

Fig. 3 shows the benefit from the "topping turbine" in another way. A small increase in total fuel used is accompanied by a large increase in power developed. These curves take no account of the benefits from the increased feed heating possible with higher pressure nor of probable gains in boiler and furnace efficiencies due to modernized equipment. It is reasonable to expect that in many cases the gain in capacity can be obtained without any increase in fuel cost.

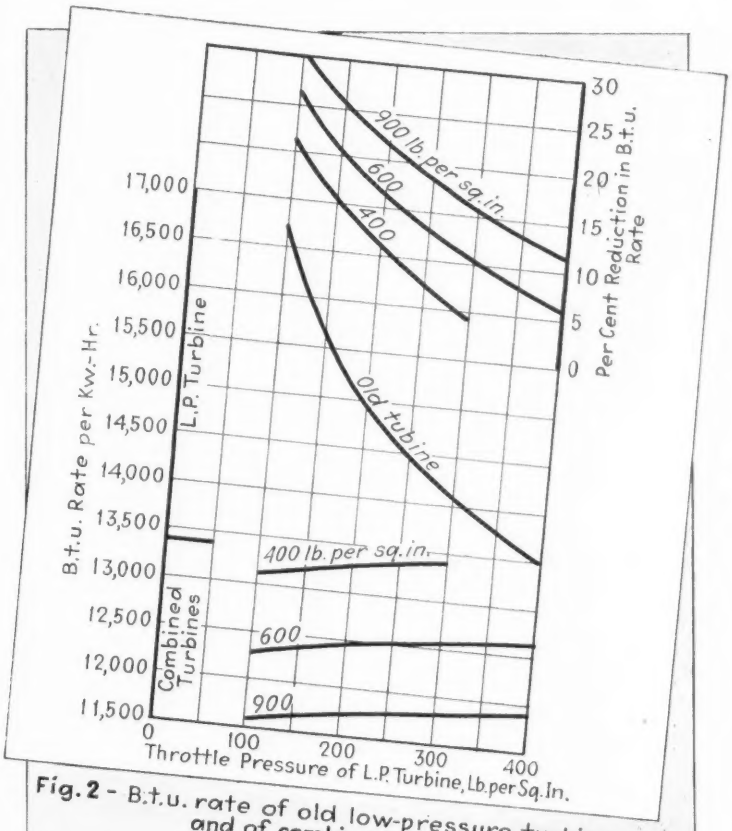

Fig. 2 - B.t.u. rate of old low-pressure turbine and of combined turbines

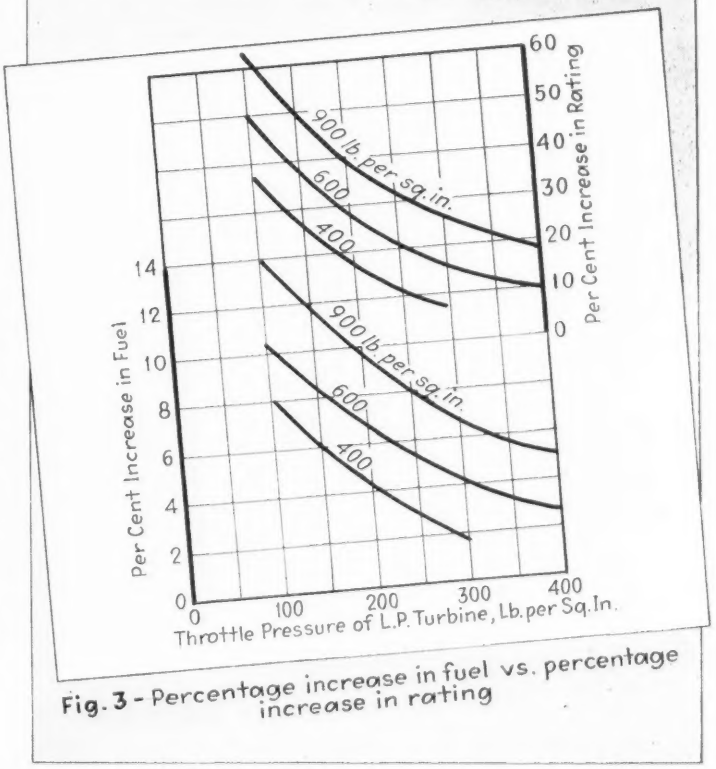

Fig. 3 - Percentage increase in fuel vs. percentage increase in rating

1 Cu. Ft. Air Burns 100 B.t.u.

By James O. G. Gibbons
Consulting Engineer

THE theoretical amount of air for combustion required to produce 1,000 lb. of steam under standard conditions is practically constant regardless of the class of fuel burned, provided over-all efficiency does not change.

The reason is that the number of cubic feet of air at 70 deg. F. required to burn any fuel is theoretically almost exactly 1% of the B.t.u. value of the fuel. For instance, the amount of air required per pound of 19,000 B.t.u. oil will be about 190 cu.ft. and that for 14,000 B.t.u. coal about 140 cu.ft. Then the corresponding weights will be 14.3 lb. and 10.5 lb. respectively. To these we must, of course, add in practice the estimated amount of excess air. Remember that one pound of air at 70 deg. and atmospheric pressure occupies 13.3 cu.ft.

(*Power* has long advocated an equivalent rule for air required, but differently stated. Burning pure carbon, 1 lb. of air will (theoretically) handle 1,270 B.t.u. Burning pure hydrogen it will handle 1,800 B.t.u. The combustible of coal is mostly carbon, so a figure around 1,300 B.t.u. is not far off for any coal. Even with oil containing 13% hydrogen the figure is little over 1,330. Call it 1,330, then, for both coal and oil. Then note that 1 lb. of air at 70 deg. and atmospheric pressure occupies 13.3 cu.ft. and (theoretically) you see that 1 cu.ft. of air will burn 100 B.t.u. in any kind of coal or oil, checking Mr. Gibbon's rule. Here, then is a rule of thumb reasonably accurate as well as easy to remember and apply.—*Editor.*)

TEST YOUR OWN BOILERS—III

By Walter H. Wood
Combustion Engineering Co. Inc.

How to prepare samples of solid fuel for laboratory analysis is explained in this third article on boiler testing. Last month Mr. Wood told how to measure solid, liquid and gaseous fuels.

A COMMON source of error in making efficiency tests of steam generating units burning coal or coke is in obtaining and preparing a sample of fuel for analysis. In many cases, a small amount of the fuel is placed in a covered container at frequent intervals during the test. After the test is ended, the container is emptied onto the floor, the sample turned over a few times with a shovel and made into a cone shaped pile. The pile is flattened somewhat, then divided into quarters. Two opposite quarters are discarded, the remaining two mixed together, made into another pile and again quartered. This procedure is carried on until each quarter contains perhaps 20 to 30 lb. A jar or can with a pressure top is filled from one of the quarters, sealed and sent to a laboratory for analysis and moisture determination.

Any such method is crude and should be avoided. In mixing and quartering the sample, some moisture will be lost. The different sizes of the fuel are not likely to be properly mixed. If only a portion of a last quarter is taken for laboratory analysis, that sample may contain too much coarse or too much fine fuel to be representative. The following method of sampling fuel on a test is recommended.

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A number of bags of light weight canvas or other similar material, and a balance are required. They should be large enough to hold 10 or 12 lb. of fuel. The number required will depend on the length of the test. At ½-hr. intervals during the test a bag should be filled with the fuel, leaving ample room for tying the bag. Immediately after filling it should be weighed on a balance, tied and placed or hung in a warm, dry atmosphere. Weight of the sample and the bag should be recorded. The samples should be allowed to dry for at least 10 or 12 hrs. after the last bag is filled. They should then be re-weighed and their weights recorded. After weighing, the contents of the bags should be emptied into one pile on a clean dry floor. Any fuel remaining in or on the bag should be removed and all of the bags weighed. Total weight of the bags subtracted from the total weights of the samples before and after drying gives the net weights of the samples before and after air drying. The difference in these weights represents the weight of moisture lost by air drying. Moisture lost divided by the net weight of fuel before drying gives the loss of moisture in per cent. This is only a portion of the total moisture in the fuel. The remainder is determined in the laboratory.

After the fuel is emptied from the bags, the laboratory sample is made up from the accumulated samples. Method of mixing and quartering the accumulated sample is of utmost importance. The floor should be swept clean over an area large enough to accommodate two piles of the weighed fuel sample, and to allow room for walking around the piles. Pick up less than half a shovelful of the fuel, turning the shovel so the fuel runs to one side. Begin spilling the fuel from one corner of the shovel, on a clean portion of the

Fig. 1. Forming cone

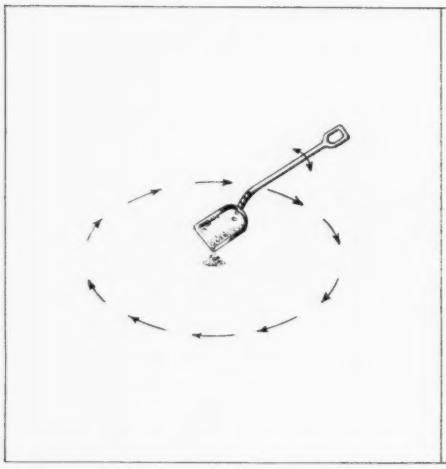


Fig. 2. Finished cone

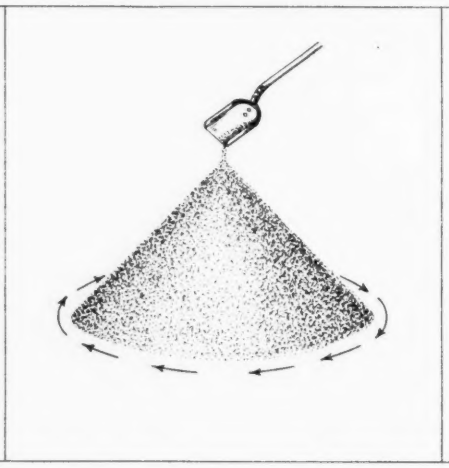


Fig. 3. Flatten cone with shovel

floor, at the same time walking in a small circle around the point where the fuel is falling. Continue piling the fuel in this manner until all of the sample is "coned." Fig. 1 shows the position of the shovel when spilling the fuel on the cone, and also indicates by arrows the path to be followed around the cone. The fuel can be made to fall on top of the pile by gently rocking the shovel. This method insures an even distribution of sizes throughout the cone.

After the pile is made as described, it should be flattened by cutting a point of the shovel into the apex of the cone as indicated at *C* in Fig. 4, at the same time walking around the pile. The sample will spread out and become thin enough to be quartered. Mark the flattened pile by two lines at right angles, intersecting at the center. The shovel should not be dragged along the fuel while marking. Quartering is done along the markings, beginning at the edge of the pile and working toward the center. One shovel can be cut vertically into the pile on the marking, and another shovel used to remove the quarter to be rejected. After removing two opposite quarters and sweeping the floor between the two remaining quarters, the fuel left on the floor should be mixed together and another cone formed, flattened, marked and quartered as just described. This should be continued until each remaining quarter is no larger than necessary to fill the sample jar. Lumps in the fuel sample should be broken down before making the first cone and each new cone. Lumps in the final sample should not be much over $\frac{1}{2}$-in.

An analysis of the fuel sample should include at least moisture and heating value. A proximate analysis, showing volatile matter, fixed carbon and ash is often of value as a means of identifying a type of coal, and for comparative purpose. Moisture found by the laboratory in a sample which has been air dried is not added directly to the moisture found by air drying. For example, if the loss in moisture by air drying fuel in bags is 6% and that determined by the laboratory is 1%, the total moisture in the fuel is $.06 + .01 (1 - .06)$ or 6.94%. Heating value determination should be made by a skillful and painstaking chemist.

Analysis of ash pit refuse should cover combustible and the non combustible matter. Heating values of the refuse are not as a rule as important as the two constituents that have just been mentioned.

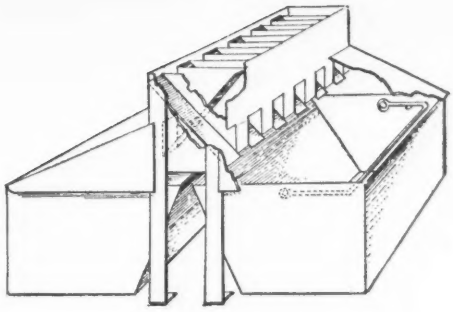


Fig. 7. Riffle for reducing fuel and ash samples

Ash pit-refuse should be weighed, and when possible the entire amount obtained during the test reduced in size by piling in cones and quartering, as described for the fuel sample. Small quantities taken at random while the ash pit refuse is being weighed may not provide a correct sample of the refuse.

Ash from a test is likely to be too large a quantity to be coned. A long ridge of the ash and refuse should first be made by spilling the ash along a straight line on a floor, then flattening and quartering the pile. Distribution should be made from both sides of the ridge to distribute the sizes evenly. The ridge should not be over approximately 30 in. in height for ease in working. By flattening the ridge and dividing it lengthwise and crosswise, and rejecting opposite quarters, the amount can be reduced to about 400 or 500 lb., and the material can then be formed in a cone and reduced by quartering. The method outlined for preparing fuel samples should be followed in obtaining samples of ash pit refuse.

Fuel and ash samples can be reduced rapidly and accurately by a riffle such as illustrated in Fig. 7, consisting of two banks of narrow triangular chutes so arranged that when the sample is placed in the hopper, one half of the material will be discharged through the chutes to one side, and half to the other, into suitable pans. One half is discarded, and the other half put through the riffle again. An advantage in using a riffle in sampling is that the material must be crushed to a proper size, otherwise it will not pass through the riffle. Any good tinsmith can make a riffle suitable for testing purposes.

Fig. 4. Flatten by cutting surface

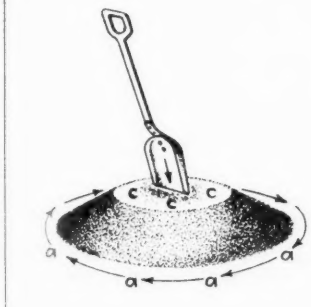


Fig. 5. Pile ready for quartering

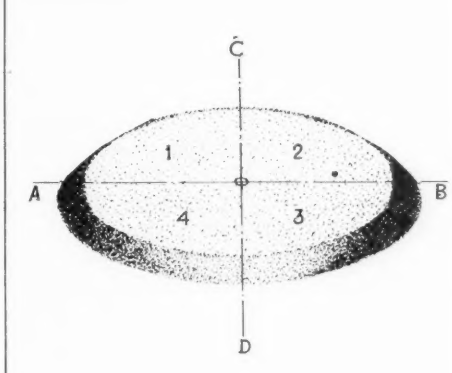
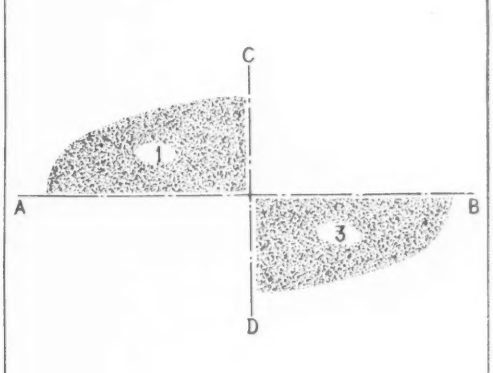
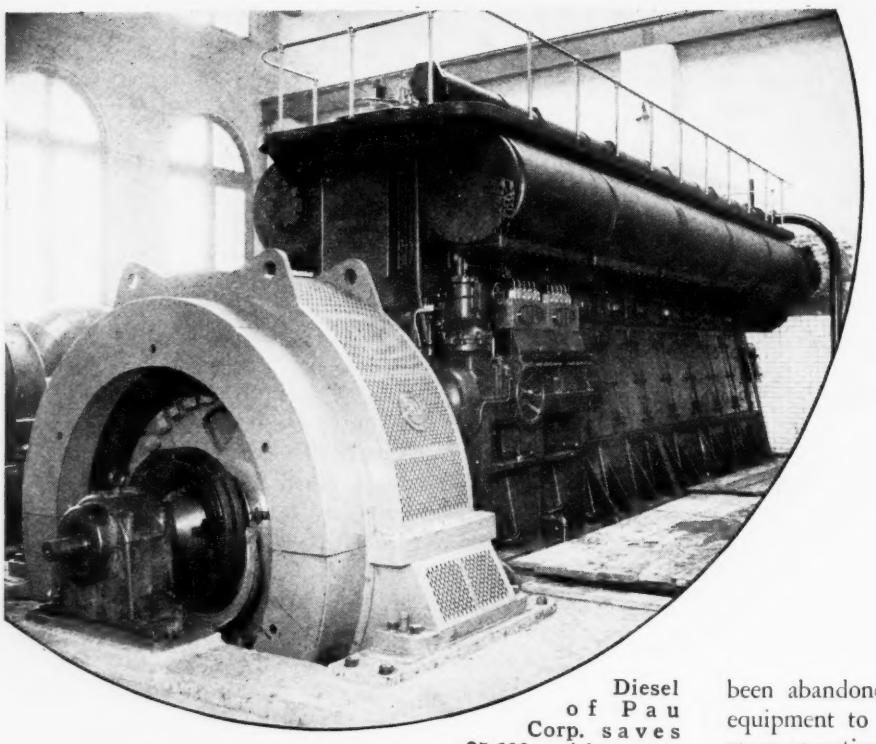


Fig. 6. Two quarters rejected



MIXED POWER PLANTS

By Paul M. Thayer



Diesel of Pau Corp. saves $7,600 with steam

MOST engineers believe that power plants should contain but one type of prime mover. Some, in fact, contend that a plant should contain only one make of apparatus of a given type. One of the principal reasons they advance is that operators capable of handling one kind of equipment cannot handle another nearly as well, and that two types of prime movers cannot be made to work successfully in synchronism.

Many American plants refute this fallacy. Notable examples are the steam-diesel combinations in the Singer Building (*Power*, June 1935, p. 299), Morgan Street Plant of Pau Corp., Union Stock Yards, Chicago, and Doubleday, Doran & Co., at Garden City, L. I.

Some mixed plants are the result of the desire to modernize an old plant with minimum capital investment, using old equipment for standby and peak-load service and new to generate most of the power. But there are also many opportunities for new combination plants.

Planning a Plant

In planning a power plant, too many engineers think only in terms of electrical energy, instead of remembering that electric power is sometimes secondary to steam for heating or process, hot water for heating, laundry, etc., refrigeration, etc. It is in this type of plant that mixed steam and diesel set-ups have the greatest opportunity.

One of the widest fields for generating equipment is in larger office buildings, stores and hotels. Such plants have worked out very successfully for R. H. Macy & Co., world's largest department store, and Hotel New Yorker, New York City. Many similar projects have been abandoned because of the high cost of proper equipment to insure continuous operation and maximum operating economy under the widely varying load characteristic of such installations. In most cases this excessive first cost could be largely eliminated by more careful examination of actual work to be done.

Development of high-speed diesels of large power and small dimensions for rail service makes it possible to avoid the former objection that rental value of space in large buildings given over to power production was greater than possible savings in power produced. Development of more efficient non-condensing steam turbines using relatively high initial steam pressure and superheat have also aided. Designers of steam-generating equipment have produced complete units economical in space, first cost and operation. All these combine to give the present-day engineer a marvelous opportunity to show real ingenuity in layout of a plant.

Power plants equipped 20 and 30 years ago almost always had a unit for night and Sunday load, one for day load, one for peak load, and often a spare of the same capacity as the peak-load unit. Usually only one of these units is used at a time, the other two or three being idle. Of course, such an arrangement shows better theoretical fuel consumption than a plant of fewer and larger units. But over-all economy is lower. Higher lubricating and repair costs alone would more than overshadow any possible fuel savings, and additional capital charges would create a heavy loss as compared to a more rational plant.

To illustrate possibilities of a mixed steam and diesel plant for downtown buildings in a large city, let us take for example a large Loop store in Chicago, typical of many such buildings in large cities. This store has a large restaurant, a laundry, a beauty salon, and a complete retail department store. The building must be heated in winter and cooled in summer; power must be provided for elevators, ventilating fans, and a thousand and one other things; lights must be provided when needed; large quantities of hot water must be furnished

for the restaurant, beauty salon and laundry; refrigeration must be furnished for drinking water, restaurant, etc. All of these services must not fail and must be provided with minimum cost.

Let us first check how requirements for these various services dovetail. The season and the weather have a lot to do with the amounts and the times at which light, power, heat, and hot water are required.

Light and hot water demands vary with weather and crowds. The major requirements for heat comes in the six winter months, and drops off to almost nothing in summer. Requirements for electricity are lower in summer than in winter, although variation is not large. It may even be reversed entirely if refrigeration is furnished by motor-driven compressors. Power peak load usually lags about an hour behind heat peak load, just the reverse of what it should be for economical operation.

A brief analysis will explain this. In the winter the store must be heated up before it is opened in the morning; this is the heaviest heating period of the day, and about the lightest electrical load period as lights are usually not required and elevator service is not heavy. Crowds coming in before noon create a smaller heating peak, while elevator service is much heavier but the lighting load is at a minimum. Crowds leave in the middle of the afternoon and the store must be heated for the night, creating another mild heating treatment. The electrical peak of the day is reached shortly afterwards when the lights are on full and the elevators are busy carrying late shoppers and employees down for the night.

Sudden Cloudy Weather

Any sudden cloudy weather may call for full lighting load without appreciable warning. Hot-water load is fairly steady, building up from a minimum in the morning to a peak around noon, and tapering off until closing time. Refrigeration is largely seasonal and depends in amount on the air-cooling program. The type of refrigerating system installed has a lot to do with the design of the balance of the power-plant equipment.

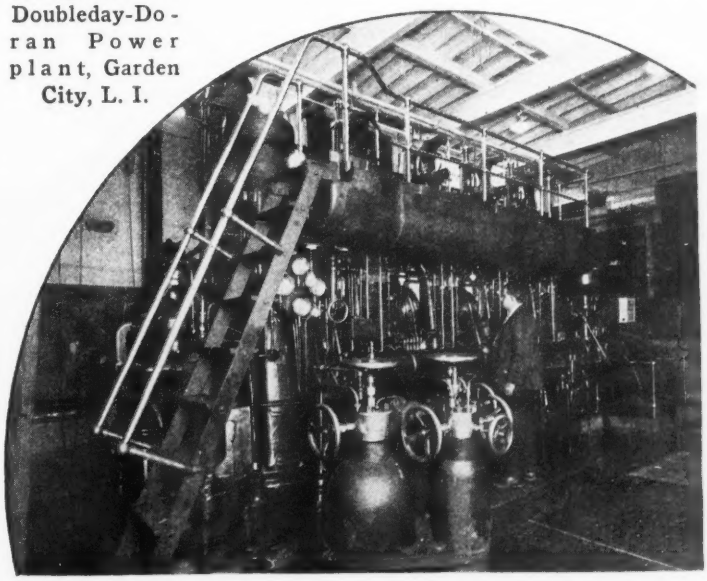
This analysis shows that changes in power load on the proposed plant are wide in range and often come unexpectedly. Changes in heating load, both for building and hot water, are easily predictable as to time, amount and duration.

There is no cheaper electric power than that obtained from steam used for heating also; it is therefore highly desirable to get as much power from heating steam as possible. It is also desirable to get the rest of the power from the most economical source. These two purposes must be accomplished without excessive investment in equipment, as additional fixed charges could easily wipe out any saving in operating cost.

Modern developments indicate that the economical plant for these conditions is frequently diesels combined with a high-pressure, non-condensing steam-turbine set-up. Pressure and superheat should be worked out so that steam at the exhaust nozzle of the turbine has a few degrees of superheat so that dry-saturated steam is delivered to the heating system normally. Fuel can be delivered in small quantities during low traffic hours, necessitating only small storage space.

Cooling water for diesels has often been a serious problem in downtown installations, particularly where the engineer tried to design the plant like ordinary power producing installation. Since cooling water in this congested location is almost of necessity the same water as that used throughout the building for hot water in service, it is obvious that heat absorbed from the diesel jackets should be considered as one source of heat for the entire system. This also applies to heat absorbed from cooling coils of the refrigerating equipment. When it is considered that hot-water requirements of a large beauty salon may be in excess of 100,000 gal. per day, and that hot water required for a restaurant and laundry runs into large figures also, it will be seen that the need for a large cooling capacity to remove engine cooling water heating is practically eliminated, even in hot summer weather. Storage of all heat obtainable from the diesel and cooling coils of the refrigerating equipment, coupled with boosting of this stored water temperature by means of diesel waste-heat boilers, just about provide hot water necessary to furnish all departments of a store adequately. It is necessary, however, to provide quite a large hot-water storage capacity to handle divergence of load requirements for hot water and power. Requirements for hot water may be such that it is desirable to run jacket water through heat exchangers. This results in less efficient heat balance and possible loss of some jacket water to the sewers.

Choice of unit size calls for ingenuity and a fine distinction between fuel efficiency and dollar efficiency. The modern solid-injection diesel has a very flat fuel consumption curve, which eliminates all need to fit the size of engine exactly to the load, and to have a big engine for a big load, a small engine for a small load, and two or three other engines for intermediate loads. The same thing is true, but to a lesser extent, with steam turbines and steam-generating equipment. Most plants of the type we have been discussing have too many units of too many different sizes. The increased fixed charges resulting from such a layout more than offset any possible fuel economy. It is dollar economy that pays dividends, not fuel economy.



400-hp. diesel of Doubleday-Doran Power plant, Garden City, L. I.

HEATING NEW YORK'S

Driveway in 15,000,000-cu.ft. post office extension heated by unit heaters and air blast preheated with heating system condensate

VENTILATION of the addition to the New York Post Office was described in the July number. This article deals with the heating of this 15,000,000-cu.ft. 5-story extension which was somewhat complicated because the building is constructed over the tracks of the Pennsylvania Railroad.

General heating is supplied by a vacuum system using cast-iron radiators in the work section and cabinet or concealed radiators in the offices. Building heat loss was calculated for 70 deg. inside with 0 deg. outside. No infiltration was considered in rooms where ventilation is supplied because 100% is supply air and only 75% exhaust air. In rooms without either supply or exhaust, one air change is taken per hour for a distance of 20 ft. back from the windows. In rooms having exhaust only—such as lockers and toilets—two air changes are allowed for the same distance back from the outside wall.

All steam and return risers are furred in and covered. All runouts to the radiators are above the floor and are exposed between the furring and the radiator. On ceilings under areaways and roof, sufficient ceiling radiation has been installed to take care of the areaway and roof slab losses.

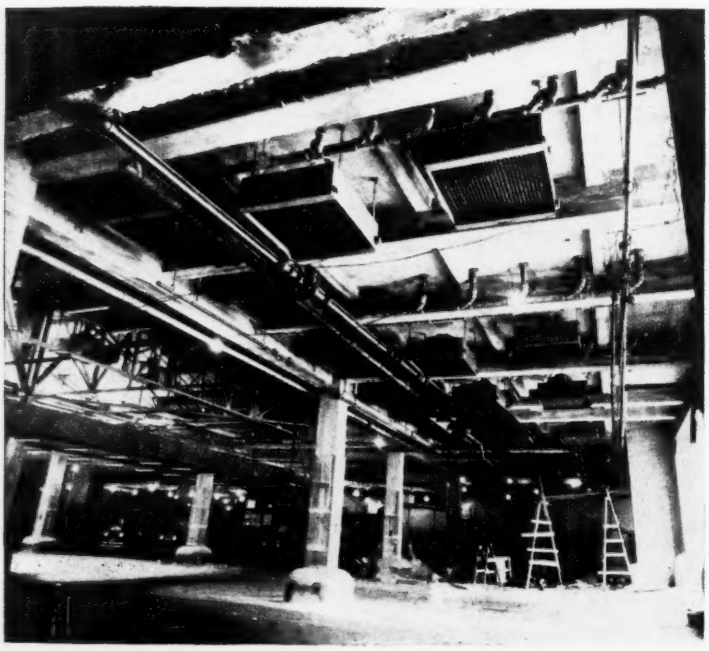
Separate vacuum pumps are installed for the north wall, south wall, west wall, and light well wall, ventilation heaters and unit heaters.

Unit heaters are used in the building for two purposes, (a) to heat the basement floor where returns must go back on the ceiling because railroad space is below the floor and (b) in the driveway entrances.

Electric lights, conveyor motors, body heat and steam lines all contribute to heat production in the basement, and unit heaters were considered as very desirable in order to drive this heat down onto the general floor area where it may be utilized and at the same time warm the cold floor slab over the railroad tracks.

For this reason the units are arranged with thermostatic control so as to close down the heating element first and the unit motor later with the idea that much of the time there will be sufficient heat collecting at the ceiling to warm the floor if it is blown down onto the floor. Thus the steam consumption will be considerably reduced.

Interior of driveway, showing unit heaters



Driveway Heating

Unit heaters are also used at entrances to the driveway which comes in from 33rd St. at the middle of the building then turns at a right angle and leaves from the Ninth Ave. end. To keep carbon monoxide content in the air in the driveway down to a point at which it has no harmful effect, air is removed from this driveway at the rate of 500,000 c.f.m. through exhaust ducts.

This air, however, enters from the outside through the open driveway doors with the exception of 100,000 c.f.m. of warmed air supplied from condensation cooling apparatus described later. To temper this 400,000 c.f.m. of incoming air from the street, unit heaters are hung on the ceiling adjacent to the two entrances and have sufficient capacity to heat this air to 70 deg. F., (a) when a west wind is blowing and the whole 400,000 c.f.m. may come in through the Ninth Ave. entrance or (b) when a north wind is blowing and the whole 400,000 c.f.m. may come in through the 33rd. St. entrance.

These unit heaters are controlled from thermostats placed on columns running back toward the center of the building so that more and more heaters will be turned on as a falling temperature penetrates farther into the driveway. A schedule of the various sizes of units installed is given in Table 1.

Steam Supply

Steam is supplied to the building by an 8-in. steam main from the New York Steam Corp. at approximately 100 lb. pressure, is metered and reduced to 50 lb. gage, and is then reduced again by secondary pressure reducing valves to 5 lb. to 2 lb. for the vacuum heating, for the unit heaters and for the hot water heaters. Steam for ventilation is carried up to the fan rooms at 50 lb. pressure and is there reduced to 5 lb.

On the low-pressure side of each low-pressure reducing valve, compound pressure and vacuum gages and safety valves guard against excess pressure. Safety valves are not used after the 50-lb. pressure reducing valves,

LARGEST POST OFFICE

By Harold L. Alt
Engineer, Gibbs & Hill

as a temporary increase in pressure in these lines would cause no particular damage.

Steel pipe of standard weight is used for all steam lines and for exposed return lines. Concealed return lines are made of iron-pipe-size copper pipe. All steam and return piping is covered with standard thickness of 85% magnesia pipe covering, canvas jacketed where exposed.

Condensation Cooling

It was found that the hot water used would be entirely inadequate to extract the heat from the heating system condensate during severe weather. To cool adequately the condensation it was decided to take 100,000 c.f.m. of outside air and, after passing it through a tempering heater where its temperature is raised to 35 deg. to avoid danger of freezing, to pass it through heaters of the copper-tube extended-fin type. Condensate discharged from the vacuum pumps is pumped through the tubes, and the air is raised from 35 to 90 deg., while the condensation is cooled from a maximum of 180 down to 100 deg.

Air at 90 deg. is then passed through steam heaters where its temperature is increased to 120 deg. At this temperature it is discharged into the driveway to take some of the load off the unit heaters. After leaving the air heaters, the condensation is carried to an economizer consisting of a 1,000-gal. tank with 333 sq.ft. of copper tubing through which the condensation flows, after which it is delivered to the sewer.

Cooling in the economizer is obtained by passing all the cold water make-up for the hot-water service supply for the entire building through this economizer before it enters the hot-water heaters.

Steam flowmeters are used on all the main steam branches for two purposes, first to check the steam corporation's main meter readings and, second, to ascertain where the steam is being used and in what quantity. A schedule of the flowmeters used is given in Table 2. These meters have recorders and indicators and are installed along with other equipment (such as sump pump and sewage ejector alarms) on an engineer's board just outside the engineer's office on the fifth floor.

Automatic Control

All radiators throughout the building with the exception of those in entrance vestibules are thermostatically controlled by a pneumatic control system arranged to control either single radiators, or radiators in groups when there is more than one radiator in a single room. In the large work spaces the groups are arranged to be controlled by a thermostat in each bay so if, at some future time, partitions should be erected along the column lines, the radiators and controls would not require changing.

Exterior of the 15,000,000-cu.ft. post office extension

Ceiling radiators also are controlled in groups from thermostats on the ceiling and set to maintain sufficient temperatures to prevent condensation on the bottom of the concrete slab. Where saw tooth skylights are located, pipe coils or ceiling radiators are used of sufficient capacity to offset the glass loss and thus prevent condensation.

A system of temperature indication is provided for the use of the operating engineer, consisting of some 44 stations throughout the building, averaging about 9 to a floor, and indicating the temperature at these points on a temperature-indicating device on the engineer's board.

In all roof gutters of the building roof and in the gutters for the areas snow-melting lines are provided, consisting of 1-in. copper pipe with $\frac{1}{8}$-in. holes 12 in. center to center. These lines are supplied through valved branches from the 5-lb. steam lines feeding the unit heaters.

Table 1—Unit Heaters

No. Req'd.	Type	Location	*E.D.R.	Motor H.P.	Speed
18	DD	Driveway—33rd St.	2,590	2	850
12	DD	Driveway Skylight	2,590	2	850
24	DD	Driveway—9th Ave.	1,240	$\frac{1}{2}$	1,150
3	DD	Driveway Skylight	1,240	$\frac{1}{2}$	1,150
16	DD	Basement N. Half	342	$\frac{1}{10}$	1,150
14	DD	Basement S. Half	342	$\frac{1}{10}$	1,150
3	HD	Basement S. Wall	360	$\frac{1}{15}$	870
2	HD	Basement N. Wall	248	$\frac{1}{15}$	870
1	HD	Basement S. Locker Rm.	248	$\frac{1}{15}$	870
2	HD	Basement N. Wall	175	$\frac{1}{15}$	870
1	HD	Basement S. Storeroom No. 35	175	$\frac{1}{15}$	870
1	HD	Basement S. Toilet No. 9	175	$\frac{1}{15}$	870
1	HD	Basement N. Toilet No. 3	99	$\frac{1}{15}$	870
1	HD	Basement S. Wall	99	$\frac{1}{15}$	870

*E.D.R. is equivalent direct radiation with entering air at 60 deg. F.
DD Indicates down-discharge units or horizontal-discharge units with special elbow.
HD Indicates horizontal-discharge units.

Table 2—Steam Flowmeters

No. Req'd.	Size of Line, Inches	Max. Flow, Lb. Per Hr.	Location
1	3	2,000	Line to Kitchen
1	$2\frac{1}{2}$	1,800	Line to H.W. Heaters
1	6	20,000	Unit Heaters on N. Half
1	6	20,000	Unit Heaters on S. Half
4	2	600	Lines to Roof Radiators
4	5	8,000	Lines to Fan Rooms and Floor Heaters
4	3	1,500	Lines to Radiators on Outside and Light-well Walls

ICE-CREAM PLANT GOES TO OIL FIRING

By Paul R. Unger
Mid-West Heat Service Co.

ABOUT a year ago we were called to one of the National Dairy Products Corp.'s plants to see if economies might be effected in their method of making steam.

The plant contained two scotch marine boilers, each with a dutch oven extension, using Illinois screenings at approximately $3.50 per ton. Besides the necessary engineer on each shift, three firemen and one relief fireman were used, as steam was needed night and day. Stoker firing was impracticable because the firing tube was too small for internal stoker firing, its inside diameter being only 33 in. To stoke the dutch ovens would have created an extremely crowded condition, as there was but little more than 4 ft. between the front of the ovens and the boiler-room wall. It would also have been necessary to pit and water-proof the floor under them.

Evaporative tests disclosed an efficiency of approximately 50% with hand firing. With the high ratings necessary, the firemen had to watch their fires constantly. Consideration was then given to oil, and a cost comparison of the two fuels made. It showed, with 12,000-B.t.u. coal at $3.50 per ton and 50% efficiency:

$$\frac{12{,}000 \times 2{,}000 \times .5}{350} = 34{,}300$$

useful B.t.u. were obtained for 1c.

Heavy bunker *C* oil with an approximate heat content of 152,000 B.t.u. per gal. was available at 2.98c. per gal. With a carefully laid-out control system, an average efficiency of 75% could be maintained. With this fuel:

$$\frac{152{,}000 \times .75}{2.98} = 38{,}200$$

useful B.t.u. would be obtainable for 1c.

A fuel saving of approximately 10% might be expected. Savings of $5,000 per year could be accomplished in labor alone. After an analysis of the fuel-oil market, the plant was converted to oil firing.

The coal room, which lay alongside of a railroad siding, was selected for the location of two 7,500-gal. oil storage tanks. These tanks were arc-welded on the premises. A seamless spiral steel heating coil was wrapped around the suction and return pipes. Suction, return, and coils were set in a manhole so that they could be easily removed for cleaning. The steam coil connections were welded through the manhole cover eliminating, as far as possible, any leakage into the coil. Without this precaution it would be possible to get oil in the boilers through a leaky fitting. A second manhole in each tank provides access to the tank without the necessity of removing the coils or suction stub. The suction line was not provided with a foot valve. This was omitted as being unnecessary with heavy oil and also as a possible source of trouble.

Although not used in this particular layout, I have, on other installations, provided two suction stubs in each tank, one low suction terminating 2 in. from the bottom and one high suction, terminating 8 in. from the bottom. In case of sediment or water formation, the burners can continue operating from the high suction while sludge or water is being pumped out through the low suction. This construction is especially advised where a single tank is used.

We built an oil pumping, heating, and straining unit in our shop on a steel pan. This equipment was completely piped up and tested before delivery to the job, and consisted of:

Two 1½-in. Northern Pump Co. rotary oil pumps driven by two 1,700-r.p.m. ball-bearing motors with triple V-belt drive reducing the speed to 300 r.p.m. with a capacity of 300 gal. of oil per hour at that speed.

Two 1½-in. suction basket-type strainers piped so that either one could be cleaned without a shutdown.

Two oil pump relief valves with handwheel adjustment so that quick and accurate changes of oil pressure may be made.

One Johnson straight-tube type oil preheater with 10 sq.ft. of heating surface, constructed with external oil and steam connections so that the oil tubes may be easily cleaned without disconnecting either oil or steam. This heater was equipped with thermostatic control set to maintain the oil at the proper temperature. With the grade of oil selected, a temperature of 185 deg. was found to be the most efficient operating temperature. A temperature of approximately 110 deg. is maintained in the storage tanks, which has proved adequate for smooth easy pumping.

A 2-kw. electric heater was connected in series following the steam heater. The electric heater was also equipped with thermostatic control and an indicating pilot. The electric heater temperature control is set 5 deg. below the steam heater and turns on whenever the steam heater fails to carry the load. This system gives immediate evidence of sluggish tubes or too low a suction temperature. Both heaters are equipped with additional relief valves placed after the heaters and before any other valves to prevent damage should the heaters be turned on without any oil flow.

The relief discharges are piped into the return line to the tanks.

Two 1-in. basket strainers of a finer mesh than the suction strainers, following the electric heater. These are also piped in parallel and strain only the oil actually burned.

Mercury thermometers are provided at the suction to the oil pumps and at the discharge of both the steam and electric heaters. The suction line to the pumps has a vacuum gauge and the pumps have a pressure gauge.

One oil meter designed to meter hot, heavy, oil was installed.

Heaters, meters, traps, etc., on this pumping unit are all by-passed. Thus operation may be continuous while any part is taken down for repair or cleaning. Correction for temperature of oil must be made, as the expansion of oil is approximately 1% per 25 deg. rise in temperature, and the oil is purchased at 60 deg. F.

The discharge line from the pumping set to the burners is a double circulating line passing through each burner up to within 6 in. of the nozzle and running back into the pump relief line to the tanks. After each burner is a gate valve. Before starting the burners this discharge valve is opened, circulating oil throughout the system. Not until the entire piping system is cleared of cold oil is the circulating line closed and the burners started. This system prevents smoke and carbon that would form if this grade of oil were burned cold at the start.

All hot oil and steam lines are covered with standard asbestos. Heaters are covered with $1\frac{1}{2}$-in. asbestos, $\frac{1}{2}$-in. asbestos plaster and canvas wrapped.

The burners used are of the Todd horizontal-rotary type mounted on extension fronts with secondary air brought into the combustion chamber from top, bottom and both sides. This method of taking in secondary air provides excellent distribution for a scotch marine boiler and an intimate mixture of air and oil.

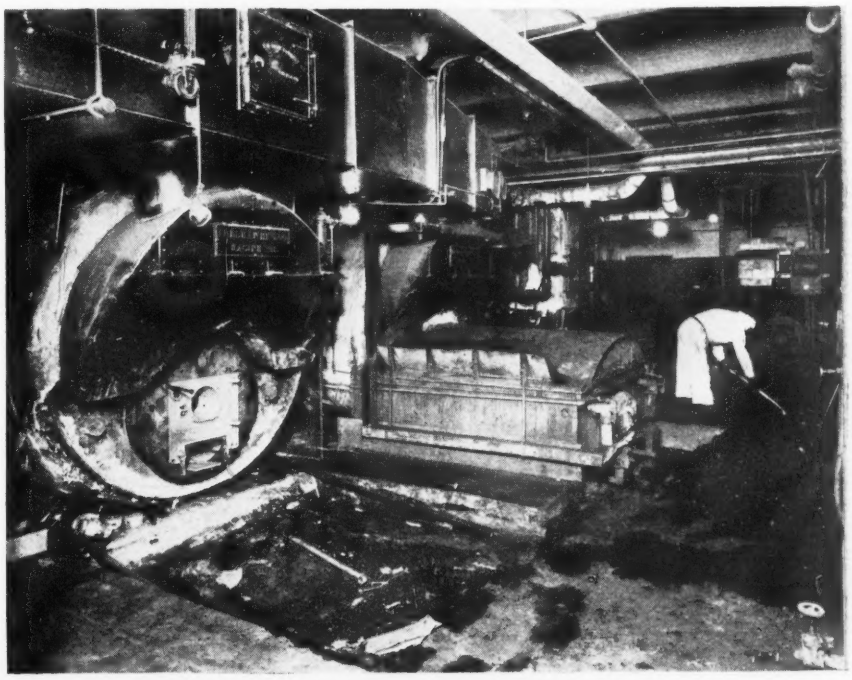
The burners were each equipped with the following safety controls: 1 low-water cut-off, 1 high-pressure cut-off, 1 stack safety cut-off. All safety controls are wired in series with the burner motors. A spring-type air-oil interlocking valve is mounted on each burner and connected with a copper tube to the pressure side of the fan. A drop in fan pressure due either to motor or other difficulty immediately turns off the oil supply. All safety controls are manually reset, giving the engineer opportunity to check the trouble before starting again.

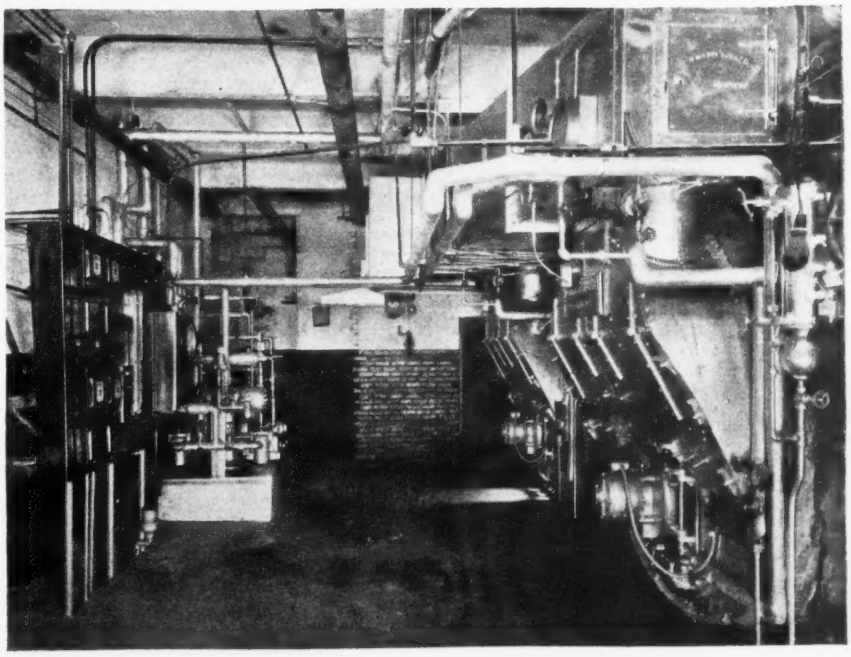
The steam pressures required at this plant are 75 lb. in the daytime and 35 lb. at night. The load is extremely variable. For example, a single can washer which is used intermittently draws almost 3,100 lb. per hr.

We decided on a Minneapolis-Honeywell electrical modulating control system to synchronize the oil delivery and stack damper setting, maintaining the required steam pressure. All control equipment and starters were built on a panel switchboard which also held the calibrated oil gages and CO_2 stack temperature and draft recorders.

The control system is actuated by two pressurestats, built on the Wheatstone bridge principle. One of these is set at 75 lb. the other at 35 lb. A double throw switch changes the control from high to low pressure. These pressurestats are connected to an oscillating damper motor at each boiler. Damper motors are each built with an integral oil valve providing a varying

The boiler room before and after modernization





rectangular orifice with maximum and minimum adjustment. Linkage connection with the stack damper provides proper synchronization of air and oil. This system of control will vary the fuel burned from 10 to 70 gal. per hour per boiler and will stop anywhere in between if the steam demand is constant at any point. No hand adjustments of the secondary air openings or the primary air dampers from the fan are necessary. Once set, these remain constant all control being effected by the individual uptake dampers.

When the system was first started and all flue-door leaks eliminated, a CO_2 of approximately 14% was obtained, but was difficult to hold because of the variations in draft conditions. A barometric damper was then installed between the individual stack dampers and the stack, and an indicating draft gage installed on the boiler side of the balanced damper, which provided a constant draft on the discharge side of the individual boiler dampers.

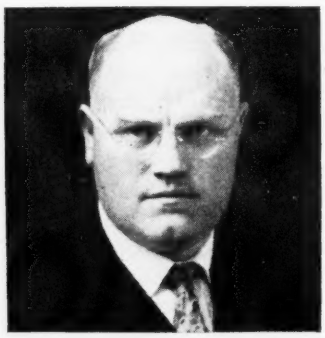
It is now possible to operate this plant with a CO_2 variation of from $12\frac{1}{2}$ to 14% throughout a 24-hr. period, with a load variation of from 930 to 6,500 lb. per hr.

The cost of changing to oil was about $6,000.

CORNING FIGHTS THE FLOOD

By Alfred Vaksdal

Plant Engineer, Corning Glass Works



Early in July floods devastated upstate New York communities. Alfred Vaksdal, *Power* contributor, plant engineer of the Corning Glass Works, was in the thick of it, fighting to maintain power services and protect the 200-in. telescope disc. We asked Mr. Vaksdal for the story. He tells it here, as one engineer to another.

FOLLOWING a series of cloud bursts and a break in a dam on one of the Finger Lakes, the Chemung River, which flows close by the Corning Glass Works, rose 18 ft. above normal during July 7 and 8. Muddy water covered the subfloors of our plant. More than thirty motors were completely submerged. Glass production was materially curtailed. Power house operation and the supply of fuel (natural gas) was threatened.

The annealing kiln for the 200-in. telescopic disc was well above the high water mark and therefore escaped damage. However, the electrical equipment operating the annealer had to be moved to a higher elevation. During this time the power was necessarily shut off, but we feel certain that this temporary interruption will not harm the disc.

We tried desperately to prevent a break in the cooling process by walling in the electrical equipment with brick and sand bags and pumping out the leakage. The city fire pumper helped us, but the water was steadily rising, so we finally shut off the power and relocated the electrical equipment on a higher level.

Did it Rain?

In this scramble to save the world's greatest telescopic eye we neglected to keep the motors dry. The power was shut off. As the water crept up on the starting boxes the fuses were pulled or the electric branches broken. After this there was nothing to do but to keep the power house going and prevent a break in our fuel supply. Not until the next day did we know how close we were to a complete shut down. Further down the river the dyke had given away and the floods had undercut over 100 ft. of gas line.

The motor-driven compressors, located on the river bank some distance from the power house, were flooded. Water poured into the air intake of the steam driven compressor at the power plant, but the newly installed gas-engine driven compressor could be operated to supply emergency air requirements. Motors for our industrial water system were under water, but the city furnished our needs.

A few days before the flood we had an unfortunate breakdown on our largest A.C. generating unit, the gas-engine driven generator. Yet we managed to supply the factory with essential electric energy to keep the temperature up on the glass furnaces and prevent a break in our air-cooled furnace walls.

Circulating water for the condensing unit is taken from a crib in the river through a 30-in. pipe to a set of twin strainers in a concrete sump. As the river came up, we gradually closed the intake valve in the 30-in. pipe and so held the water below the strainers. Later we closed the valve entirely but the leakage was

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Straight-Line Diagrams Simplify

ELEVATOR-CONTROL PROBLEMS

By Charles A. Armstrong

BECAUSE of the large number of functions performed by modern elevator controllers, their wiring diagrams are necessarily complicated. This difficulty can be reduced considerably by using straight-line diagrams, in which each circuit is taken from the complete diagram and laid out so that it can be easily studied. Such diagrams can sometimes be obtained from the elevator manufacturer, but these are frequently lacking in information essential for quickly tracing out the circuits in case of trouble. The figure, a straight-line diagram of the potential-switch circuit of an Otis type 3 MVU, unit-multivoltage control for car-switch operation, illustrates what can be done with such diagrams.

Starting at the + terminal of the exciter on the control panel the potential-switch coil circuit is through fuse No. 1. This fuse does not protect the potential-switch-coil circuit alone, but all the control circuits going through the two-pole knife switch on the control panel. From fuse No. 1 the circuit is through potential-switch blowout coil, one pole of the knife switch and fuse No. 3. This fuse and No. 4 are the protection for the potential-switch-coil circuit. After going through fuse No. 3 the circuit is to terminal $+L$ at the top of the control panel. On this diagram all terminals with a circle around them are at the top of the control panel. This easily identifies them on the diagram and if they are properly marked on the control panel no trouble should be experienced in quickly picking out parts of the circuit.

From $+L$ terminal the circuit goes into the main hoistway conduit through a top and a bottom hoistway limit switch and back to $+P$ on the control panel. It then passes through resistance *ARP*, auxiliary contact *Pa* and potential-switch coil. Contact *Pa* is closed when the switch is open and opens when the switch closes to cut resistance *ARP'* in series with the coil. This resistance reduces the current in the coil to a value that will just hold the switch securely closed.

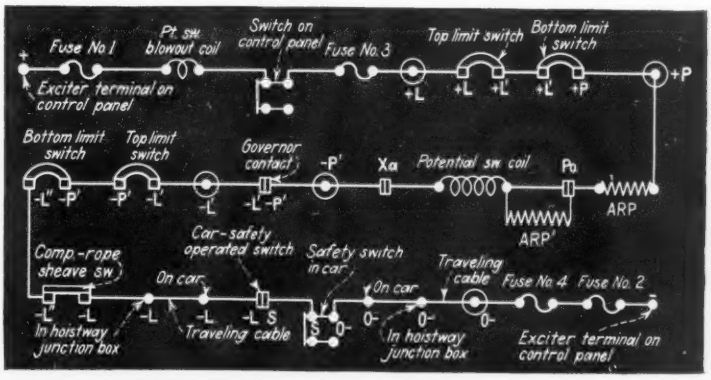
Contact *Xa* on the minimum-current shunt-field relay is the next in circuit. This relay's coil is in series with the elevator-motor shunt-field circuit. Unless this field circuit is energized above a predetermined minimum value, relay *X* will not close, consequently the potential switch cannot close. This prevents the brake being released from the car switch until the elevator-motor field has been excited. From contact *Xa* the circuit goes to terminal $-P'$ at top of the control panel and through the normally closed contact on the governor and returns to $-L'$ terminal on the controller.

The governor has two sets of contacts, one, normally closed, and one, normally open. The normally open contacts connect across the resistance in series with the elevator-motor shunt-field winding. Should the car start to over-speed, the governor would first close its normally open contacts and cut the resistance out of the elevator-motor field circuit to slow it down. If this failed to be effective and the speed continued to increase the normally closed governor contacts will open and trip out the potential switch. This should result in a heavy dynamic-braking action by the motor to stop the machine. If this operation failed and the car continued to overspeed the governor would apply the car safeties to the guide rails.

Going from $-L'$ terminal on the controller the circuit is through the other top and the bottom hoistway terminal limit switches and the slack-rope switch opened by the compensating-rope sheave, in case the ropes are too long. The circuit then runs to the hoistway junction box and into the traveling cable to $-L$ on the car terminal board. It then goes through the switch opened by setting of the car safeties to the operator's safety switch in the car. From here the circuit returns through the traveling cable to the hoistway junction box and back to $O-$ terminal on the controller, where it is completed through fuses Nos. 4 and 2, to — terminal of the exciter, near the bottom of the control panel.

The markings on the straight-line diagram are the same as those on the complete diagram, with the exception of the two terminals in the hoistway junction box. These have been added to make the connections complete so that their location can be readily determined. If the potential-switch-coil circuit is complete when the exciter builds up its voltage the switch should close.

If the switch fails to close, first check for normal exciter voltage on the control panel by inspecting minimum shunt-field current relay *X* to see if its contacts *Xa* are closed. If these are not closed then check the exciter voltage, with two 110-volt test lamps in series. When relay *X* closes its contacts and the potential switch will not close then test the fuses by connecting the test lamps between terminals $+L$ and $O-$. When light is obtained, test between terminals $+P$ and $-P'$. If the lamps light it shows that all limit and other switches are making good contact. The trouble is probably in the potential switch coil, contact or resistance.



QUIET FANS FOR AIR CONDITIONING

By A. Warren Canney

Air Conditioning Engineer, New York, N. Y.

This, the eighth of a series of articles on air conditioning, tells of the factors that influence fan selection and how they are put to practical use.

WHENEVER a centrifugal fan supplies a duct system there are two elements that are always in balance, namely, system resistance and fan characteristic. Regardless of errors or inattention to detail, these elements will always balance, but we must know where if satisfactory fan and system performance are to be obtained.

Flow of air through an air-conditioning system is turbulent and the friction of air under turbulent flow varies in proportion to the square of the volume for all practical purposes. This is described by the formula

$$\frac{p_1}{p_2} = \left(\frac{Q_1}{Q_2}\right)^2 = \left(\frac{V_1}{V_2}\right)^2$$

where p_1 is the static pressure corresponding to the volume Q_1 and the velocity V_1.

This formula is important in fan selection, and to make it seem more real let us imagine an air-conditioning system on which tests have shown the static pressure across the fan to be 1 in. of water, and the air delivered 10,000 c.f.m. If the fan is speeded up or another fan added, so that 20,000 c.f.m. is passed through the same system, then the measured resistance would be 4 in. of water. Every air-conditioning system, when completed, and with all factors influencing its resistance stable, has a definite resistance pressure to the flow of a specified volume of air. This is called "system resistance."

The second element, fan characteristic, is established by the manufacturer's design. Test performance curves in catalogs usually show how pressure, horsepower and efficiency vary with changes in volume of air delivered for constant speed operation.

Three types of fans are available and widely used in air-conditioning practice in duct systems. They are distinguished by the curvature and position of their blades with respect to wheel rotation. There is the forward blade type which cups the air and consequently discharges air at a velocity more nearly corresponding to the peripheral speed of the blade, and the opposite blade position or backwardly curved blade. Fig. 1 shows characteristics for fans of these two types.

There is a third classification of fans with intermediate or combination forward and backward blade forms which fulfill many requirements. Their curves lie between the two types shown. Straight or paddle wheel blades have been displaced by the above three types in air-conditioning work. Propeller fans need not be discussed here, as resistances usually exceed their design duties.

The main thing to be observed in these fans is that the forward curve type fan has a flatter pressure characteristic at the higher pressure, a horsepower curve which keeps going higher as the volume of air handled is increased, and a hump which shows that two different volumes of air may be delivered at the same static pressure. But, when once installed on an independent system, it is impossible to secure two different volumes at the same system resistance. Likewise, with proper analysis, it is perfectly possible to prevent motor overload with the forward curve type, even though it does not have the limiting horsepower consumption characteristics of the backwardly curved fan.

Backwardly curved fans operate at peripheral speeds approximately $2\frac{1}{2}$ times that of forward curved fans. The high speed of this type makes it adaptable for direct-connected electric motor drive. Lineal dimensions of this type fan averages 25 per cent, and the cubical space 100 per cent above that required for forward curved fans. Efficiencies obtainable with both types are substantially the same.

The first thing to do is to establish whether a constant volume of air is to be supplied by the fan. If so, and if excessive resistance fluctuations will be encountered, then a backwardly curved type fan is to be selected. If a constant pressure is desired at the outlet, but with varying resistances occurring in the system due to dampering individual runs of supply ducts, then a forwardly curved type of fan is indicated. If constant volume is to be obtained by automatic static pressure control, the latter type of fan is usually more suitable. If considerable uncertainty in the ultimate system resistance exists at the time of final design, with constant volume desired, then a backwardly curved type is indicated, but a forward curved type may be selected just as safely, if careful analysis of horsepower requirements is made.

The performance of a fan is to a considerable degree dependent on installation conditions with regard to streamline flow into the inlet and from the discharge. Inlet connections as ordinarily encountered, increase the brake-horsepower about 8 per cent over the catalog rating for the desired air volume. Although these factors, plus air leakage from duct work, do introduce unknowns which only experience can closely approximate, still resistance pressure should be estimated with reasonable accuracy.

In determining system resistance the same principles

apply as for ventilating practice; use manufacturer's data for the resistance of apparatus interposed in the duct system, and standard methods of estimating duct friction (available in handbooks). It is important to apply the flow formula previously given to figure resistances for apparatus when air volume differs from that for which the manufacturer's friction pressure loss data is listed.

Many filter catalogs give only the resistance when clean, whereas resistance actually increases as the filter becomes dirty. Filters impose a variable resistance on a fan, which must be considered because of its effect on volume, pressure and motor-horsepower. If cold air is being delivered vertically, allowance should be made in the estimated fan pressure for elevation difference and the greater density of cold air. In determining the system resistance at the required volume as closely as possible, do not "pad" or insert factors of safety, for trouble will surely follow from noise, possible overload control difficulties and high operating costs.

Having determined system resistance for the required air volume the "system resistance" curve can be plotted by applying the formula given. The characteristic pressure volume curve of the fan type selected must intersect the system resistance curve at the point of required volume and pressure. If a forward curved fan is selected the point of intersection of the fan characteristic with the system resistance curve should not occur at the peak of the pressure-volume curve but to the right of this, and usually between 40 to 50 per cent of the fan's capacity under full-open conditions. Highest fan efficiency occurs between this range, and the fan should be selected so it will operate under these conditions. In backwardly curved fans the highest efficiency occurs at 55-65 per cent of full-open capacity. Selecting a fan to operate within this range permits operation on the steep part of the pressure volume characteristics, which helps to maintain constant volume conditions in the system.

When a fan with forward curved blades is used the rising character of the horsepower curve makes it necessary to estimate the variation in system resistance that might occur due to changes in damper setting dirty filters, etc., so that the drive may be selected to avoid over loading. Effect of such variation is shown in Fig. 2. It is assumed that the fan has been selected so that it will deliver the required volume at the highest system pressure likely to occur, as indicated at *A*. If clean filters and damper changes were to drop system resistance 33% to *B*, the curve shows the volume will increase 13.5% to B^1 and the horsepower 19.5% to *b*. Again, if two fans operating in parallel are installed to serve a given system, they should be motored to care for the increased power demand if one fan is operated alone.

In air-conditioning work considerable care must be taken in fan selection to insure quiet operation. Where noise is chargeable to the fan it is caused either by too high tip speed of the blades or too small a fan resulting in excessive velocities in the fan casing. Outlet velocities and tip speeds for forward curved fans, as follows, will usually give reasonably quiet operation:

Resistance in water	½	1	1½	2	2½	3
Outlet velocity f.p.m.	1200	1500	1900	2200	2600	2900
Tip speed f.p.m.	2000	2500	3040	3600	4200	4900

For backward curve fans tip speeds permissible for quiet operation may be taken as follows: Churches, 4,800 f.p.m.; theaters, 5,200 f.p.m.; offices, 5,600 f.p.m.; stores, 7,000 f.p.m. Generally, higher tip speeds and velocities can be used with exhaust fans, as the noise is not so readily transmitted back through the air.

Exhaust and supply fans usually do not have the same capacity. Normally the supply fan may be selected with 10 to 15% greater capacity thus maintaining a pressure in the conditioned space and preventing a leakage of outside air.

Fig. 1. Characteristic pressure-volume and horsepower curves of fans with forward and backwardly curved blades when operating at constant speed

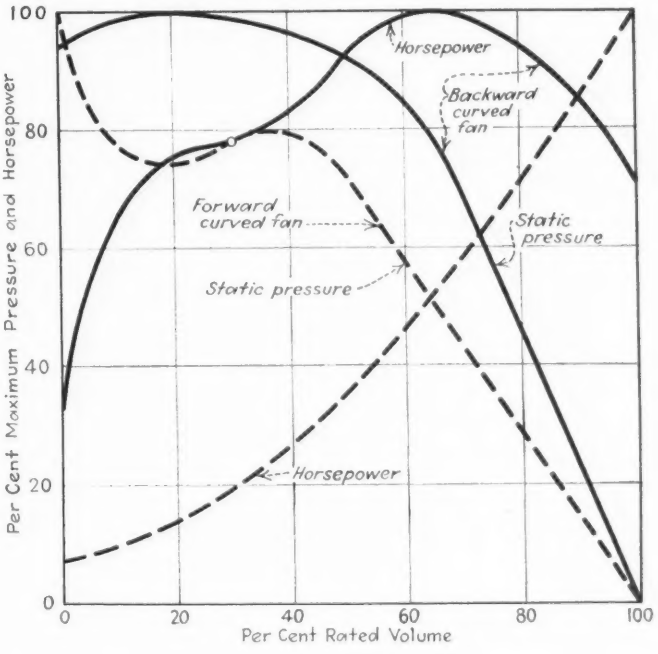
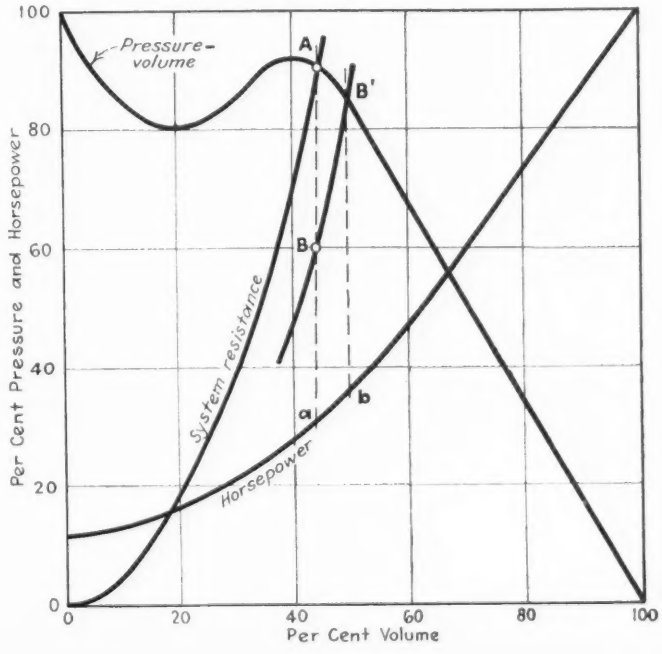
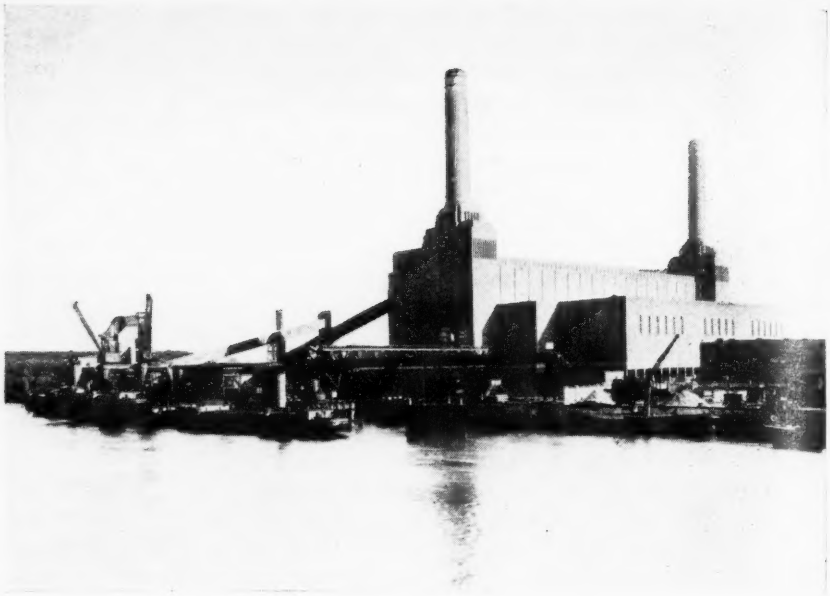


Fig. 2. When a fan with forward curved blades is used a decrease in system resistance increases the horsepower



Battersea Station from the Thames. The extensive flue-gas washing plant was described in *Power* in Sept., 1933



Britain Will Pay

THE PRICE OF CLEAN STACKS

By David Brownlie

London, England

AMERICAN power engineers will be interested in an exhaustive paper read in London at a joint meeting of the Institution of Electrical Engineers (Savoy Place, Victoria Embankment, W.C.2.*) and the Institute of Fuel (53 Victoria Street, S.W.1.*), by J. L. Pearson, G. Nonhebel, and P. H. N. Ulander, entitled "Removal of Smoke and Acid Constituents from Flue Gases by a Non-Effluent Water Process."

This describes in detail a new system of combustion gas purification, known as the "Howden-I.C.I.," worked out by James Howden & Co., Ltd. of Glasgow and Imperial Chemical Industries, Ltd., of London, which has operated for two years on one boiler on an experimental scale at the Billingham-on-Tees works of the latter company.

Essentially the system consists in scrubbing all the gas with lime or chalk sludge, using a special new design of scrubber tower, forming part of a continuous circuit. The claims made are remarkable: 97-99% removal of sulphur compounds, 97-98% of dust, 60-70% of nitrogen oxides, and 90-93% of hydrochloric acid. Modern high furnace temperature results in a small proportion of the nitrogen in the coal-forming nitrogen oxides (nitric acid, HNC_3) while the hydrochloric acid (HCl) results from chlorides in the ash. The sulphur of the coal is almost entirely converted into sulphur dioxide (SO_2), with a small amount of sulphur trioxide (SO_3).

Another feature of the process is that no effluent is formed, the lime or chalk sludge being re-circulated and the excess sludge continually removed, fresh lime or chalk and water being added to keep volume constant. Sludge is filtered in rotary suction pumps or other apparatus and the clear liquor returned to the circuit, leaving the sludge in the form of relatively hard cakes for disposal in the form of a waste product.

As far as Great Britain is concerned, the stack top completely without smoke, grit, dust and acid compounds is now becoming standard practice for power stations. At Battersea station (London) now of 160,000 kw., with another 100,000 kw. being installed, all flue gas is scrubbed with water, which requires about 20 tons of water per ton of coal burned, followed by use of a small amount of lime. This removes the sulphur compounds in solution in the water, the effluent being discharged to the River Thames.

The new Howden-I.C.I. system is now to be installed in two new British power stations at present under construction, Fulham (London) and Tir John (Swansea), while experimental work on different lines using lime water or sludge has been undertaken on one boiler at Barton station (Manchester).

The reason for this new development in power-station practice is the enormous concentration of coal burning at one spot representing anything from say 1,000 to 5,000 tons of coal per 24 hr. Thus in the case of only a moderate-sized station the burning of 1,000 tons of coal in the latter time, containing 1.5% sulphur and 12% ash, discharges to the atmosphere 15 tons of sulphur, or 45 tons expressed as sulphuric acid (H_2SO_4), along with about 30 tons of dust with mechanical stoking and 70-90 tons of dust with pulverized-fuel firing.

Battersea station was allowed to be erected in the middle of London only on condition that drastic methods would be adopted to purify the waste combustion gas, and the same now applies to Fulham and Tir John.

One of the features of the Howden-I.C.I. system is the design of the scrubber towers, which are on new principles, involving use of a series of grids piled on top of one another, in two stages, built up of a special design of lath. The lime or chalk sludge enters at the top, passes downward in counter current to the combustion gas travelling upwards, and discharges at the bottom to a delay tank, followed by a special conical settling tank leading to filtering equipment.

Essentially, the whole plant, almost a chemical works in itself, consists of complicated arrangement of vertical scrubber towers, delay tanks, settling tanks, lime preparation plant, pumps, pipes, filter presses, rotary vacuum filters, spray nozzles, purging pipes, sludge storage tanks, and a special new apparatus that has been devised to give a continuous record of the alkalinity of the sludge.

The main chemical action is formation from the sulphur dioxide of calcium sulphite, ($CaSO_3$) which is then partly oxidized during the operations to calcium sulphate ($CaSO_4$). Also the sulphur trioxide in the gas combines direct to give sulphate, and in addition calcium nitrate and calcium chloride are formed. The sludge consists mainly of calcium sulphite and calcium sulphate in varying proportions, depending on the degree of oxidation that occurs, calcium carbonate, and a very large amount of grit and dust.

Net costs are of a staggering character, and two sets of figures are given in the paper, depending on whether unit pulverizing or bin-and-feeder pulverizing is used, details for mechanical stoker firing not being in-

*Reprints are available from these addresses.

cluded. All the figures also relate to a standard medium-sized power station of 120,000 kw. operated with eight boilers (six normally working) each with an evaporation of 200,000 lb. of water per hr. Coal consumption is given as 372,000 long tons per year, corresponding to 25,000 lb. of coal per hr. under peak-load conditions, which forms 110,000 cu.ft. of gas per min. containing 13.0% CO_2, calculated at 60 deg. F. and 30 in. mercury. Actual combustion-gas temperature, however, entering the purifying plant is estimated to average 275 deg. F., while the coal contains 1.5% sulphur.

So far as can be made out, two very large central scrubbing towers may be used under these conditions for the total boiler plant, or each boiler can have its own scrubbing tower. The total capital costs are (£1 sterling = $5) as in Table I.

Table I—Total Capital Costs

	Unit-pulverized fuel	Bin-and-feeder pulverized fuel
Total scrubber sq.ft.	2,800	2,800
Number of tower units	8	6
Scrubber towers and all accessories	£108,000	£83,000
Lime plant	19,000	16,000
Settling plant	23,000	22,000
Filtration plant	8,000	8,000
Foundations, etc.	7,900	6,450
Total	£165,900	£135,450

Annual operating costs Table II, are even more formidable.

Total annual charges	Unit pulverized fuel £ a year	Unit pulverized fuel pence per kw.-hr.	Bin-and-feeder pulverized fuel £ a year	Bin-and-feeder pulverized fuel pence per kw.-hr.
Capital (10%)	16,590	0.0058	13,545	0.0047
Maintenance	4,170	0.0014	3,350	0.0012
Lime	15,450	0.0053	15,450	0.0053
Power	4,900	0.0017	4,798	0.0016
Labor	2,280	0.0008	1,650	0.0006
Total	43,390	0.0150	38,793	0.0134

Table II—Annual Operating Costs

That is for bin-and-feeder pulverized fuel annual net operating costs are $193,965 (£38,793), with $216,950 (£43,390) for unit pulverizing. To summarize in round figures, a station of only 120,000 kw. would have to spend about $750,000 (£150,000) on plant and in addition incur an annual expenditure of $200,000 (£40,000), that is $4,000 (£800) per week.

Included in this expenditure is $77,250 (£15,450) per year or $1,500 (£300) per week for lime alone, of which about 10,000 tons would be used every year, about 200 tons per week. Presumably the sludge cake resulting would be at least 400 tons a week, based on 50% moisture content.

There seems to be no question that power stations will have to operate without omitting nuisance from the stacks, but the increase in capital and operating costs represented by sulphur removal is serious.

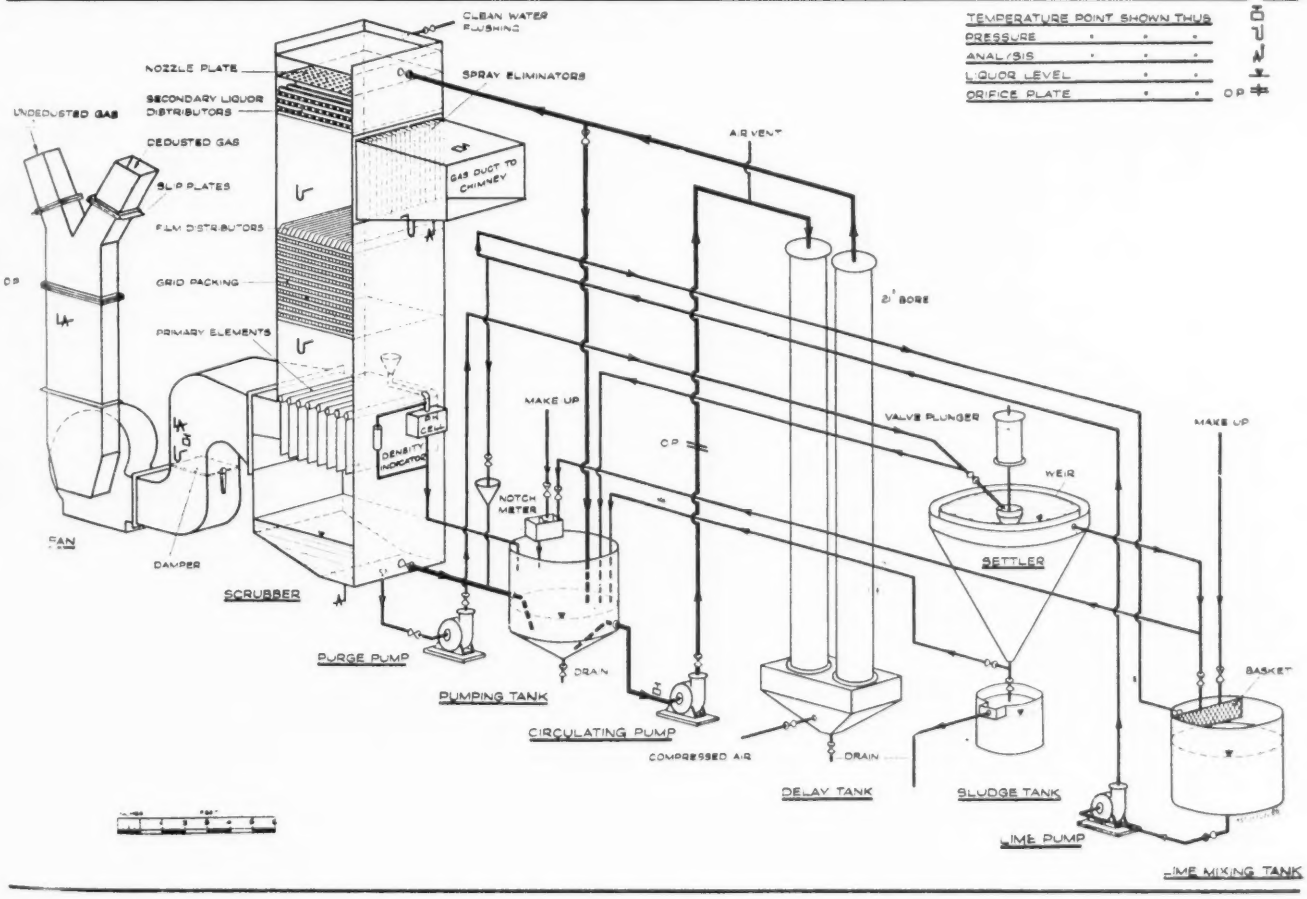
First of all it may be possible, as one alternative, to operate with enormously high stacks, say 350-400 ft., in conjunction with an electrostatic dust removal plant so as to discharge entirely dust-free gas into the upper strata of the atmosphere.

In my opinion, however, all this work is starting at the wrong end, with consequent huge capital and operating costs. To try and remove sulphur compounds from a vast volume of gases formed by combustion is not a logical or scientific policy, and the only proper method is to deal with the sulphur before the combustion chambers are reached.

For example, the coal could be gasified under combined low-temperature carbonization and total gasification conditions in vertical retort-generators, so as to recover the low temperature tar, which is extremely valuable for many countries, such as Great Britain. The resulting gas, cooled in the process, would then be treated by well-known chemical methods, such as the use of alkalis or iron oxide for the complete removal of the sulphur compounds, followed by passage through electrostatic plant to eliminate over 95% of the dust. The pure gas would then be burned in the combustion chambers.

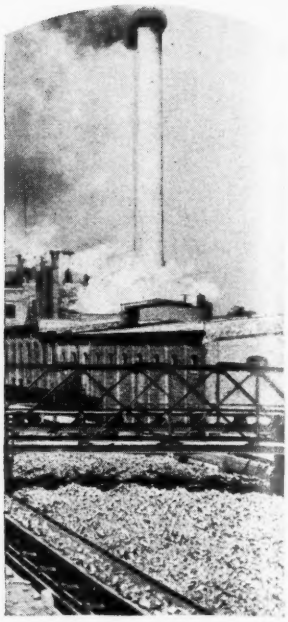
Expressing the matter in simple figures, the removal of the sulphur per ton of coal in this way would involve the treatment of about 150,000 cu.ft. of cold combustible gas instead of about 500,000 cu.ft. of hot waste combustion gas, an entirley different proposition, as regards capital and operating costs.

Isometric view of complete pilot plant at Billingham-on-Tees



STEAM PLANT ERRORS

Chapter 1—Premises*



By Frank H. Browning, M. E.
Engineer Examiner for the City of Seattle, Washington

CONFESSIONAL

Browning's book has been out over a year, but I never gave it a real once-over until recently. My hard luck. Whether or not you agree with every point Mr. Browning makes, you'll have to admit that the man has done a lot of thinking about boilers, that he never allows a rule to replace thinking, that he has a gift for asking the right question in the right way. You'll understand this better when you read the first catechising next month. *Power* has obtained Mr. Browning's special permission to reprint several chapters of his book. No. 1, here presented, tells the "what" and "why" of the book. No. 2, appearing next month, will ring up the curtain. Under no circumstances miss it.

PHILIP W. SWAIN
Editor

THIS booklet is devoted to safety in steam plants by working out a clearer grasp of the operations, stresses and effects. It covers the oldest subjects in a new way, to correct the general confusion of ideas and habits, thoughtless handling and dangerous impulses.

Our trouble calls have been reduced to one-tenth of previous records, since we discarded the old examining methods, and now judge the candidates on their practical operating sense, definite reasons for their methods and knowledge of preventive measures. These must come from a proper effort to understand the equipment and working conditions.

While we judge his clear sensible grasp and safe operating ability, each man corrects some confusion and errors as we make him reason through to the effects. This spreads the knowledge of safer handling, and often starts a valuable new interest in his plant. Our licensed men may not be mechanical wonders, but they are safe.

No one can realize the extent of unreasonable notions among steam men unless he has discussed these subjects with them, as this booklet shows. Though we were familiar with them on the job, it is now plain that the most intimate working relations do not approach a brief personal inquiry in showing the operators' grasp.

There is no desire to criticize the really competent engineers and firemen—smear them all with the same brush. We do propose to describe and help correct a condition which permits unsafe men in these plants. Recent work with them has increased our admiration for steam boilers, which generally stand the rough treatment. We must also offer our highest respects to the boiler inspectors who continually check their condition. But the inspectors cannot provide against all errors of habit or impulse.

We would be much safer if many now in steam plants were kept in places provided by the State for people without reason. But the practical steam engineer is not largely to blame for the mixture of errors and habits, relics of the old system, nor for the general failure to foresee troubles and learn good ways to avoid them, because the operating man's problems were slighted by old standards.

It was assumed that knowledge of construction of this equipment carried with it sufficient knowledge of proper operation. It was assumed that daily routine developed judgment to handle or forestall conditions which operators never experienced. We must kill or cure the amazing idea that ordinary intelligence and instinct can dictate proper relief for any trouble with boilers. And, granting that mechanical ability is very desirable, we still refuse to put the cart before the horse or let the tail wag the dog, in our licensing for safety.

Most codes and standard rules rely on memory, instead of gaining a man's sense and interest with clear explanations. Steam engineering books describe construction, and routine handling, and give a mass of scientific data about steam, water, air and heat, leaving it to the reader to select the right pieces of the jig-saw puzzles and fit them together into the necessary clear pictures of conditions, actions and results. Some job! Far too much for authors and experts who pass along

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the ancient misconceptions with statements that prove their complete lack of grasp.

Regular operations have been left to chance and whim. Less than one per cent of steam men have any approximate knowledge of the way water acts in a boiler. Examining boards of prominent engineers of the old school require candidates to study many technical formulas which really distract their attention from actual operating competence. Also, we have discovered that the mere statement of safe methods cannot, in many cases, overcome the imbedded bad habit, pet theory and natural impulse. Dangerous ideas are still left lurking in ambush as a constant menace. So, after a century of reliance on these old standards, we venture to offer a more rational basis.

After some written record, our discussions draw out the candidates' grasp and judgment, with great patience if they will only try. The follow-through is important to find the reasons and effects of their methods. Usually it needs a real mental effort, help with clear thinking and some pointed emphasis, to destroy the false ideas, before we work out safer practices.

We try to make these matters extremely simple so that men are amazed at their habitual mistakes. Then they won't forget. No group could be more pleased to clear up these errors.

This booklet shows the pattern of thousands of talks, and the widely held beliefs. It analyzes some commonest practices, absurd notions and natural impulses to discard poor ones, pick out safer methods, and gain a clearer mental picture of results. This method is essential to a definite grasp.

We present here the elements of safe operation simply and forcefully on a few typical subjects where we have found the greatest confusion and negligence. We employ whatever example or emphasis suits the purpose, and avoid splitting hairs over fine technicalities or the exact similarity of a homely illustration.

We believe the other fellow's mistakes will interest practical engineers and firemen, while their own ideas on these subjects become more definite and reasonable. We know they will welcome this first clear rational explanation of the water action in simple terms, to reduce these hazards. We hope this booklet may lead to more attention to the boiler room devices, overcome the bad effects of half reasons, encourage investigation of other subjects, and gain better operating judgment with greater safety.

BOILER CAPACITY RATINGS

By C. F. Dixon

United Engineers & Constructors, Inc.

THE practice of rating boiler plants in terms of boiler horsepower, with the nominal capacity based upon square feet of heating surface in a selected part of the equipment (which may represent all or only part of the total heating surface), and then stating the ultimate capacity in percentage of this nominal rating, creates considerable confusion in the minds of the average person confronted with the problem of providing or operating steam-generating equipment. It leads to many erroneous conclusions.

For example, when one purchases a "1,000-hp." boiler in accordance with present practice, he has acquired sufficient heating surface to absorb 33,523,000 heat units per hour at nominal rating; this same surface, however, may absorb five times this quantity of heat, in which case it is said to operate at 500% rating. Converted into steaming rate, the nominal steam delivered may be as low as 26,000 lb. per hr. or as high as 175,000 lb. per hr. for the 500% rating, depending upon the temperature of the feed and the exit steam conditions.

This wide range, however, is not attainable in all installations of the same rated horsepower capacity; there are other factors involved that limit steaming rate. To bring out these factors we will assume there are two plants, *A* and *B*, both requiring 120,000 lb. of superheated steam per hr. continuously at 250 lb. pressure and 560 deg. temperature.

Plant *A* has two "1,000-hp." boilers. They are equipped with superheaters and stokers, forced-draft fans and natural-draft stacks. Stokers and furnaces are of sufficient size efficiently to burn the fuel required for this plant. Each boiler generates 60,000 lb. of steam per hr. or the equivalent of 200% rating.

Plant *B* has one "1,000-hp." boiler. It is equipped with superheater, furnace water walls, economizer, air preheater, stoker, forced- and induced-draft fans. Stoker and furnace are of sufficient size efficiently to burn the fuel required for this plant. The unit generates 120,000 lb. of steam per hr., or the equivalent of 400% rating.

The plant as outlined for *A* will cost somewhere in the neighborhood of 10 to 15% more than the plant outlined for *B*. As *A* has a nominal capacity of 2,000 b.hp. and *B* 1,000 b.hp. it is evident that the unit cost on a horsepower basis will be lower for plant *A*. However, if the comparison is based upon units of 1,000 lb. of steam generated per hr., unit cost will then be lower for plant *B*. This indicates the fallacy of comparing boiler plant construction costs on a boiler horsepower basis.

The principal factors which affect the steaming rate of a boiler are: steam pressure drop from drum to superheater outlet, draft loss through gas passages and exit flue gas temperatures. Figs. 1, 2 and 3 show in a general way how these factors vary at different rates of flow. The curves refer to that part of the boiler heating surface on which the horsepower rating is based and does not include pressure or temperature drop

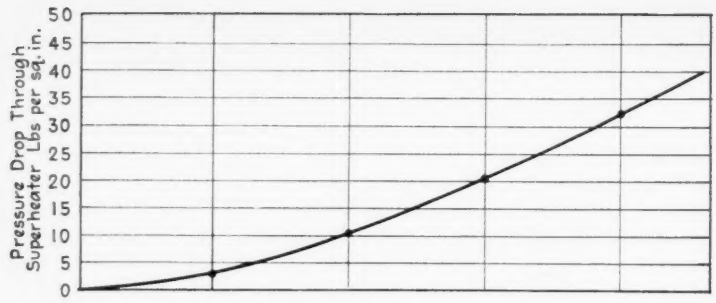


Fig. 1

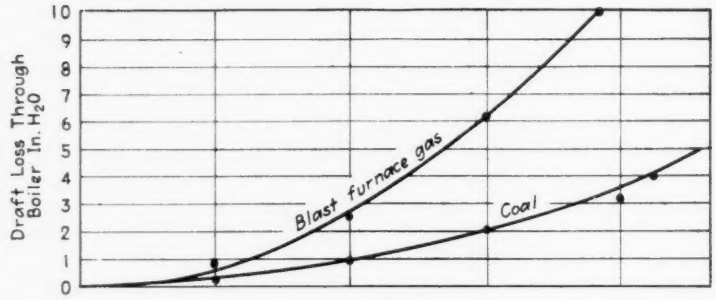


Fig. 2

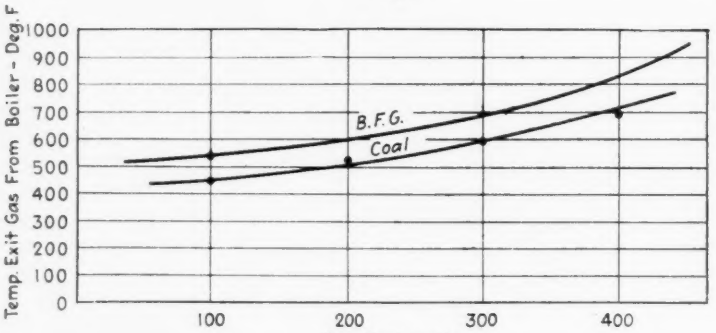


Fig. 3

Fig. 1—Pressure drop through superheater
Fig. 2—Draft loss through boiler and superheater
Fig. 3—Temperature of flue gas leaving boiler

through either the economizer or the air preheater.

Referring to Fig. 1, we find that the pressure drop for the flow as specified for Plant *A* is 10 lb. The boiler drum therefore must be designed for 260 lb. pressure in order to maintain the required line pressure of 250 lb. Pressure drop for flow as specified for Plant *B* is over 30 lb. the drum in this case must be designed for 280 lb. pressure.

Referring to Fig. 2, draft loss is less than 1 in. for conditions as specified for Plant *A* and as there are no economizers or air preheaters in this plant, natural draft will serve the requirements. Draft loss for conditions as specified for Plant *B* will be over $2\frac{1}{2}$ in. for the section covered by the curve, to which should be added the draft loss through the economizer and air preheater, making it necessary to install fans to produce the required draft.

Referring to Fig. 3, flue-gas exit temperature is seen to be in the neighborhood of 500 deg. for Plant *A*. It would be possible to lower this to about 300 deg. and thereby improve the efficiency by adding economizers and air heaters, but for this study we have assumed that the cost of fuel saved will not warrant the additional cost of equipment required. The exit temperature for Plant *B*, however, is 700 deg., and it is assumed that equipment necessary to lower this to 300 deg. is warranted.

It is apparent that although these two plants are equal on the basis of pounds of steam delivered, they are not alike when compared on the basis of nominal horsepower, square feet of surface, % rating, or possible efficiency.

The rate at which any steam-generating unit may be operated is limited by several factors that can be determined only by specific analysis of the plant in question. The quality of feedwater and the arrangement of boiler circulation may, in specific cases, limit the output.

It is generally accepted that for the present conventional boiler designs it is not desirable to run at over 500% of the so-called normal rating, as pressure loss through the superheater and draft losses through the boiler, economizer and air heater introduce losses which overcome any gain due to saving in installed heating surface. The curves of Figs. 1-3 indicate in a general way how these losses increase with increased capacity demand.

Stoker-fired plants burning low-heat-value fuels have an additional limitation in the fuel-burning surface; for high ratings this surface becomes too large for practical construction.

When one realizes the number of factors that affect the output of a boiler, it becomes evident that any unit designation which may be interpreted to cover such a wide variation of performance is not desirable.

"Pounds of steam generated" covers the basic information desired for any unit in the same way that kilowatts generated covers the basic information for a turbine generator. The other factors involved are no more peculiar to one than the other.

Corrections

The following corrections are noted in the table of Diesel Accessory and Supply Manufacturers, pages 296-298, June *Power:* The Fairbanks Co., New York, N. Y., should be listed under "Valves"; The Foxboro Co., Foxboro, Mass., should be listed as manufacturers under the headings "Temperature Controllers," "Recorders," "Pyrometers" and "Thermocouples"; The United States Gauge Co., 44 Beaver St., New York, N. Y. should have additional listings as manufacturers of "Temperature Meters" and "Recorders"; The L. H. Gilmer Co., Tacony, Philadelphia, Pa., should be included in the list of Manufacturers of "Flat Transmission Belting."

In the article, "Here's a Unit for Judging Compressors," on page 312 of the June number, a formula for friction horsepower was given as $Hp. = 105\ (Displacement)^3$. This should have been $Hp. = 0.105\ (Displacement)^4$. Also one of the curves of Fig. 2 was labeled 400 cu.ft. per min. instead of 40 cu.ft. per min. and the scale of compression ratio should begin with 1 instead of 0.

CHASING B.T.U.'S
Through a Hospital

As all power engineers know, any large hospital involves many power services in considerable quantity, notably electric power, hot and cold water, refrigeration, and low- and high-pressure steam for building heating, laundry operations, sterilizing, etc.

It is an important part of the hospital engineer's job to trace down the flow of energy in dollars to these various uses, to notice the change in quantities from year to year, to detect and correct excessive usage of any service.

It is hard to say offhand how much of the steam generated should be used for this purpose or that, but a continuing record, year after year, immediately shows up a sudden increase in any item and stirs up investigations which may save much money.

The systems used to record such facts are as varied as the men who produce them. However, many readers will be interested in the charting system developed and used by Anthony A. Fette, superintendent of the mechanical department, Cincinnati General Hospital, Cincinnati, Ohio. For the benefit of readers who may care to try something along this line, we present here a reproduction of Mr. Fette's chart showing the distribution of steam, etc., in the Cincinnati General Hospital for 1934. Column *A* pictures the heat in the coal supplied as 100%. Column *B* shows that of this energy supply, 68.1% found its way into the steam and 31.9% up the stack through boiler and furnace walls and through the grates.

Each of the succeeding columns from *C* to *I* adds up to 100%. For example, in Column *C*, 100% is taken as all of the steam passing through the main boiler header. Of this 3.8% goes to the laundry, 21.8% passes directly as live steam to buildings, 1.6% disappears as condensation and as steam supply for blowing tubes. 1.2% goes to ice-making machinery, 7.3% to auxiliaries and 36.2% to the engines generating electric power.

Column *D* similarly breaks up the total steam supply into that for primary use only (26.1%), that added to secondary steam (28.1%), and steam for both primary and secondary uses (45.8%). This latter, it will be noticed, is approximately the sum of the total steam supplied to the electric generating sets, the auxiliaries and the ice machinery.

Passing along to Column *E* we find that, of the 45.8% (Col. *D*) of steam with both primary and secondary uses, 5.3% is charged to all power and 40.5% to exhaust or terminal steam for secondary uses.

It is unnecessary to follow through the remaining columns in detail, since any engineer adapting the system would naturally change the details to suit his own plant and special ideas. Such a chart system, however, in any practical form, will prove of decided assistance.

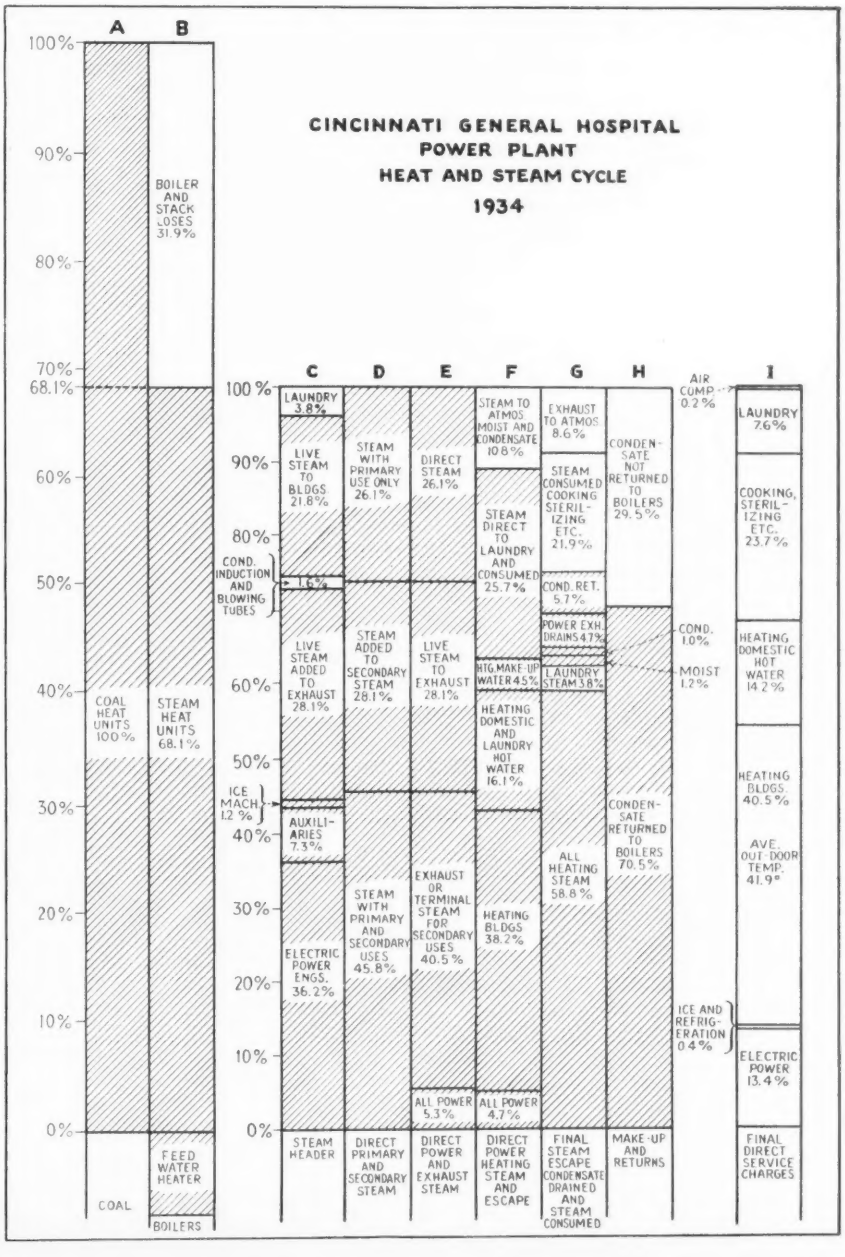


Chart form used at Cincinnati General Hospital to record the use of steam for various purposes. It is filled in for the year 1934

SPEAKING OF POWER

● NORMANDIE, Queen ship of France and the largest moving object ever built by man, docks every other week almost under my nose. From my desk on the 29th floor I look right down on her 1,029 feet of graceful line, tucked neatly into her Hudson River slip . . . July 9 several of us went aboard, armed with cameras to "shoot the works" in the engine rooms. Plenty to see down there, but nothing but French to speak. I fear that the assistant engineer, G. Orieux, who conducted us around, was pretty well fed up with my "Yank" French, although his continental courtesy never failed as he showed us the fine-looking *turbines de vapeur* and *les grandes moteurs* driving the four propellers . . . Anyway the *Power* photographer did his stuff, revealed for you on pages 434 and 435.

Should engineers study economics? I say yes, if it's the practical variety. As I see it, the kind of economics for the engineer to worry about is that of the small boy with a penny in his pocket looking at a lollypop in a grocery store window. His problem is to decide whether that lollypop is worth his penny, and he won't get anywhere by writing his Congressman about it . . . Isn't it the same with such plant decisions as modernization? Look at *your* plant, *your* costs, *your* wastes, and decide how much you can afford to keep on losing. Throw in your weight, as power engineer in plant councils of war, on the side of keeping feet on the ground and head out of the mists of political astrology. After all, your job is to cut power service costs, the direct road to greater manufacturing profits.

You can now buy a byproduct power "factory" off the shelf . . . A midwest manufacturer of butcher's supplies is marketing a combined power plant and rendering machine. The small reciprocating engine is mounted on the same base with the meat rendering machine and supplies it simultaneously with driving power and exhaust steam heat. Eliminates 50 to 60 kw. of purchased electricity. The supply of "high pressure" steam presents no problem, because the small establishments using these rendering machines have 100-lb. steam available for processing in any case.

With returning business, many inspectors admit privately that boiler explosions may soon become a greater hazard than at any time during the past twenty years. Why? Because the United States is full of rheumatic boilers. Many of War-time vintage, and older, have been standing idle and rusting during the long depression, with the ash of 1930 heaped on their cold mud drums. Year after year moisture and sulphur have been gnawing away at their weakest link, the tube ligaments. Factors of safety have been steadily dissolving. And drum heads, too weak from the start because the old A.S.M.E. Code head formula was faulty, have lost precious metal by corrosion, inside and out, where they never had an ounce to spare in the first place . . . Dangerous business! Boiler inspectors are making them dig away the bricks from blind heads and put in division plates so that the danger points can be inspected . . . Are yours hidden? Has inspection been too long deferred? Did you get turned down on insurance with one company and boast about getting it elsewhere? Are you worried? The boiler inspectors are—plenty. I know, because I've talked with them.

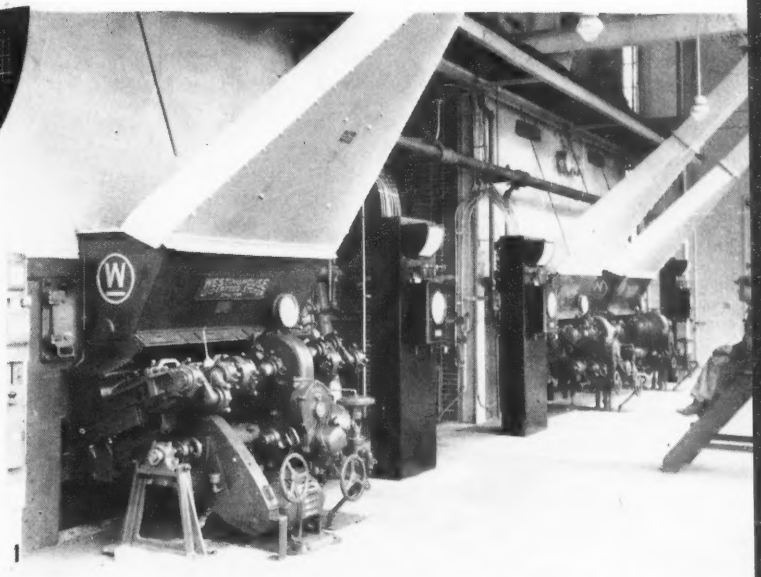
The Federal Housing Administration's booklet "Modernize for Profits," just off the press says: "The fees of a consulting engineer are a permissible expense in any modernization program under insured credit. Start your plant modernization with sound planning under the direction of a qualified engineer. . . ." We concur, not only because we feel that the consulting engineer deserves more than the crumbs he has been getting from industry's table, but also because we honestly feel that the modest fees paid to consultants who know their jobs come back in lowered costs of construction and operation.

It looks as though there might be a shortage of skilled labor before long. It's a bit out of the power field, but you will be interested to know that the National Industrial Conference Board just recently surveyed 287 metal manufacturing companies located in 21 states. This small group reported a total of 1,193 skilled craftsmen needed at once and not now available . . . And this same Conference Board reports that the durable goods manufacturing industries, which took the biggest slump in the depression, are now coming back faster than the general run of manufacturing. The level of Durable Goods is, of course, still below that of other industries. Compared with 1929 its score board reads thus: Average weekly earnings 82%; employment 69%; payroll 57%.

Sunnybrook Distillery plant, displayed on the next page, strikes me as a neat-looking job, and it shows that automatic combustion control isn't only for the very large plants. An average over-all boiler efficiency of 76% has been maintained during the past year. This is reasonably good for a plant without heat recovery. More interesting to me is the fact that 10,000 tons of coal have been burned without replacement of any stoker part.

PHIL SWAIN
Editor

Control BY METER



By Francis A. Westbrook

Center Conway, N. H.

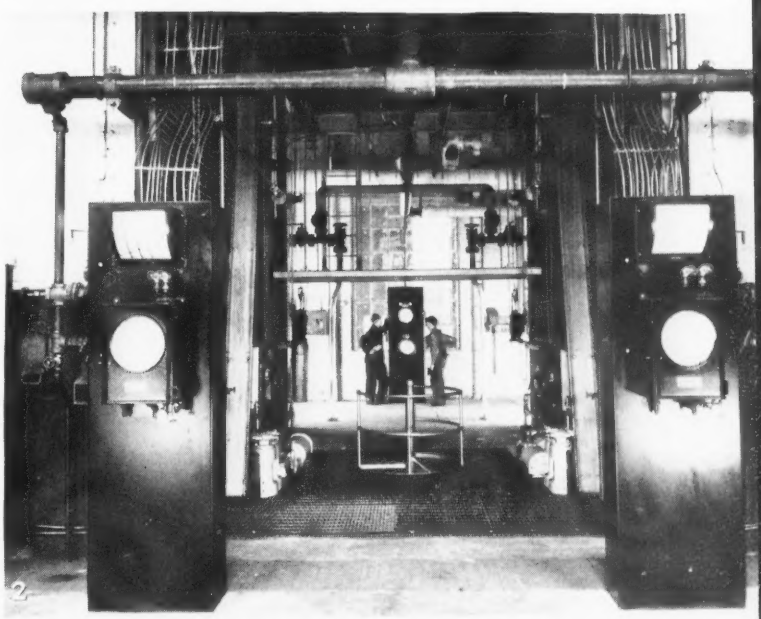
METERS and meter control make good operation a matter of routine in the Sunnybrook Distillery of American Medicinal Spirits Corp., Louisville, Ky. This boiler plant consists of three 4,000-sq.ft. boilers, fired with underfeed stokers, and controlled by a Bailey system of meter controls operating on compressed air at 35 lb. pressure. The system maintains constant steam pressure, combustion efficiency and furnace draft.

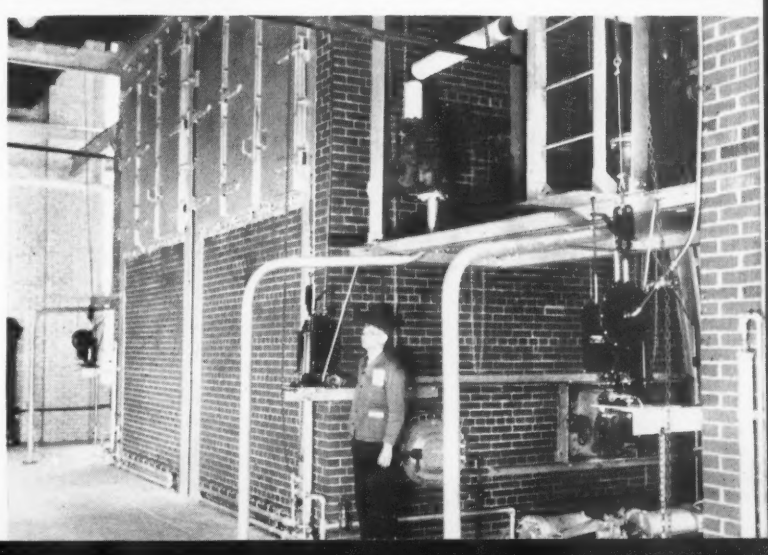
The master pressure recorder-controller operates a diaphragm motor-control valve on the steam line to the forced-draft fan turbine on each boiler. This controls the supply of air for combustion, hence the rate of combustion itself, to maintain practically constant steam pressure. At the same time, fuel feed is increased or decreased proportionately by the steam flow-air flow relation of the boiler meter acting through a valve controlling the stoker turbine.

Individual boiler control panels are shown in Fig. 1, with multi-pointer draft gage above and boiler meter below. Two of these panels may be seen in greater detail in Fig. 2, with the master steam pressure recorder-controller in the background (between the two men). The fluid meter mounted directly under the master pressure recorder-controller records and integrates total feedwater flow to all boilers.

Furnace draft in each boiler is automatically controlled by an uptake damper-control drive shown in Fig. 3. These regulators are independent of the metering equipment and incorporate diaphragms to measure furnace draft and to operate an air pilot valve in accordance with changes in furnace draft. Air pressure controlled by the pilot valve actuates the control drive to regulate the uptake damper.

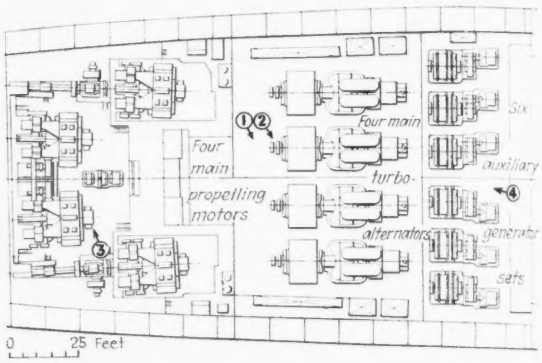
The three 4,000-sq.ft. B. & W. longitudinal-drum boilers produce saturated steam at 130 lb. for direct use in process and heating. There are no air preheaters or economizers. Each boiler is served by a 5-retort Westinghouse underfeed stoker and a Buffalo forced-draft fan driven by turbine.





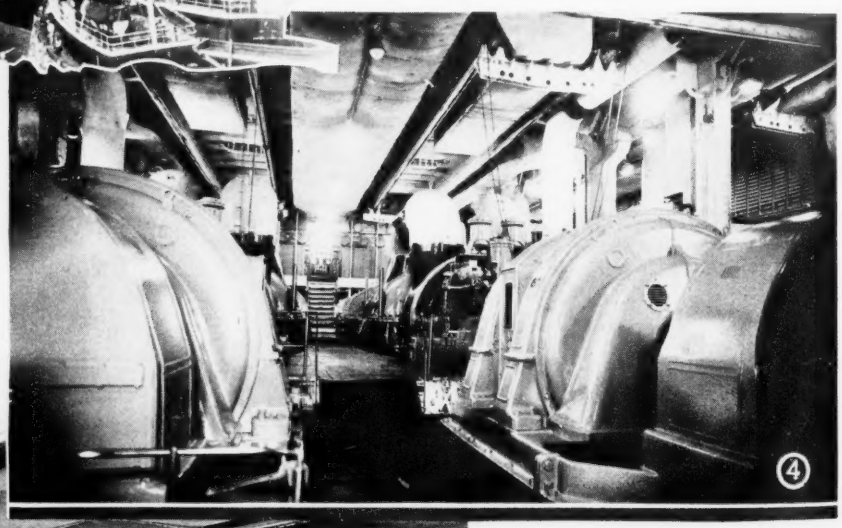
Normandie

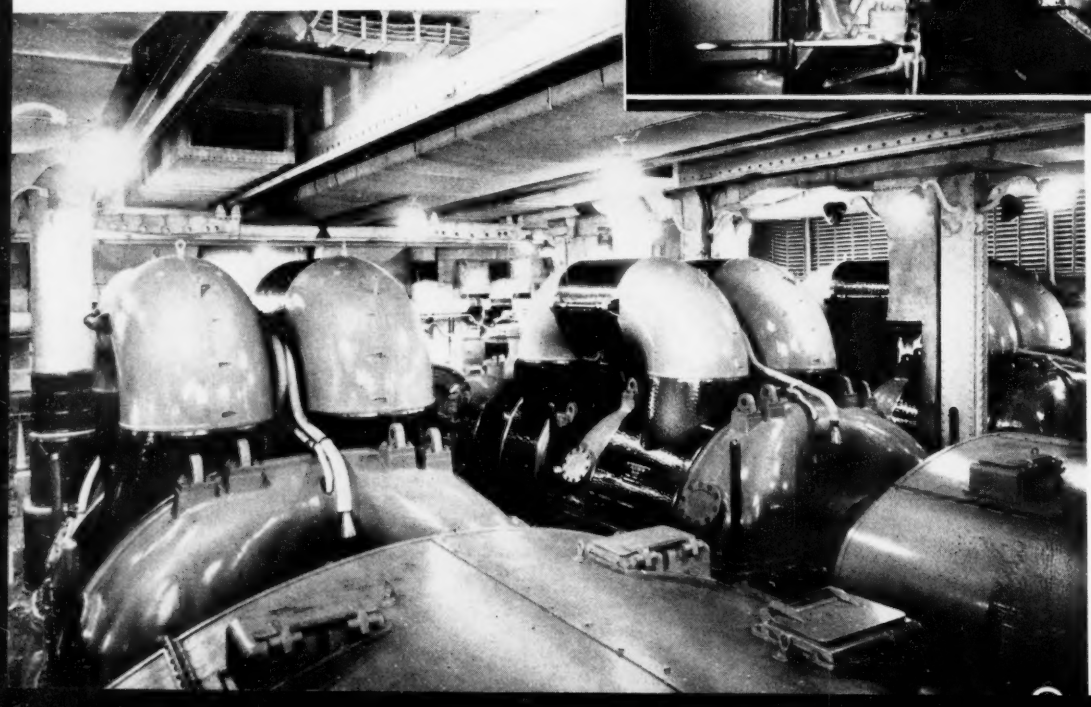
New speed queen of the Atlantic, world's largest ship, highest powered turbo-electric commercial vessel, with the four largest motors, this 79,280-ton (gross), 160,000-shaft-hp. superliner is the greatest moving object ever built by man



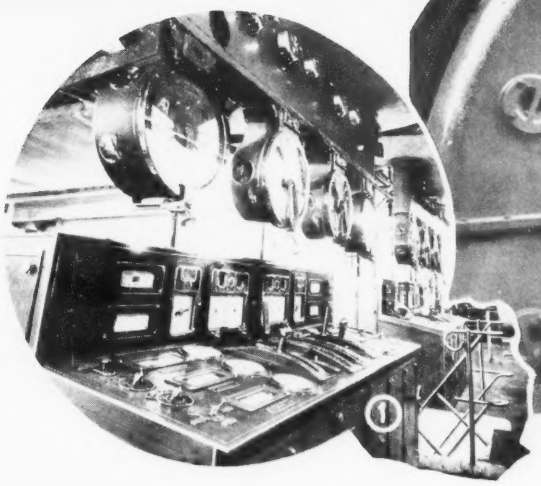
Plan of motor and alternator rooms

1029½ ft. long, 119½ ft. wide at the promenade deck, 184 ft. high from keel to top of forward funnel, 37-ft. draught, speed 32 knots (36 m.p.h.), carries 1,972 passengers, 1,345 crew (187 in engine room—total aboard 3,317), 8,930 tons fuel oil, 6,600 tons fresh water, 133,300 cu.ft. cargo space. Four 34,200-kw. main turbo-alternators, 6 auxiliary 2,200-kw. turbo-generators, 2 emergency 150-kw. diesel sets, 29 water-tube boilers, 4 auxiliary Scotch boilers. Owned by Compagnie Generale Transatlantique. Several American companies participated in design and construction, notably General Electric Co. on electrical units.

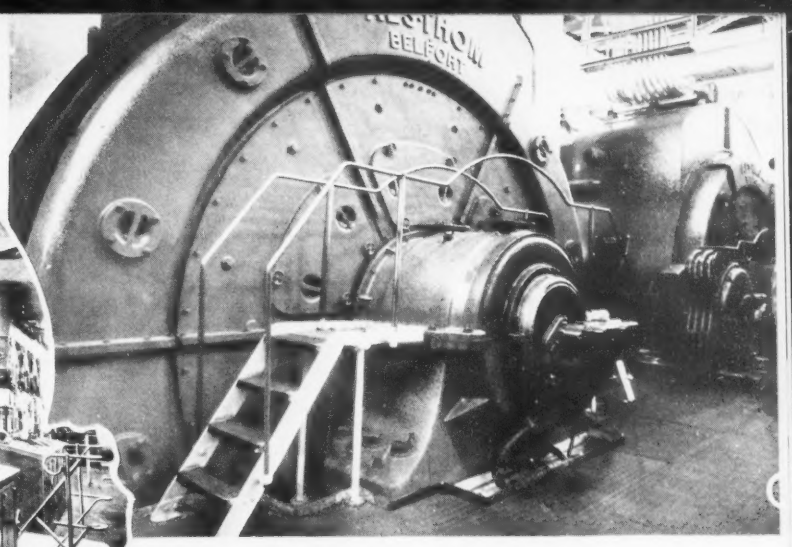




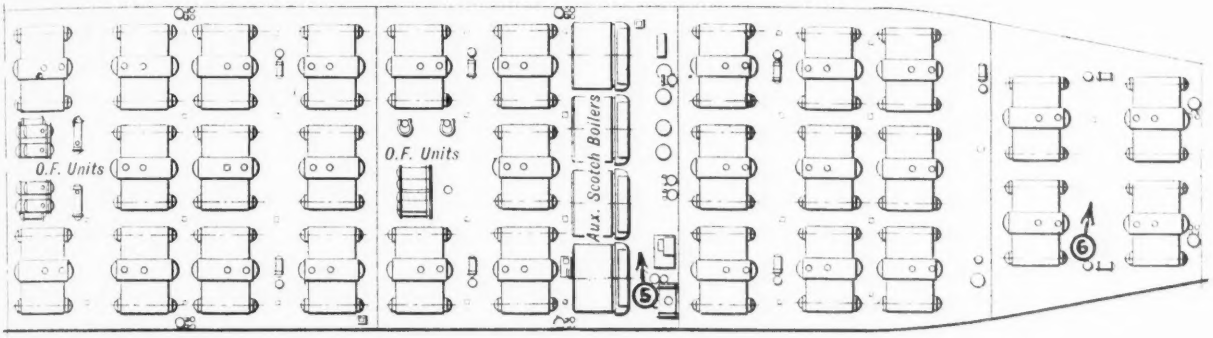
TURBINES—At left are three of the four main Als-Thom turbo-alternators, above another view shows two auxiliary sets, tops of two main sets and the control board. Main turbines are 2-cyl. impulse tandem 19-stage and run at 2,430 r.p.m. (max.). Alternators supply 3-phase a.c. at 5,000 volts. The six auxiliary sets generate 220-volt d.c. at 5,300 r.p.m.



One of the two main control stations overlooking the turbine room. Turbine speed is varied to vary ship speed



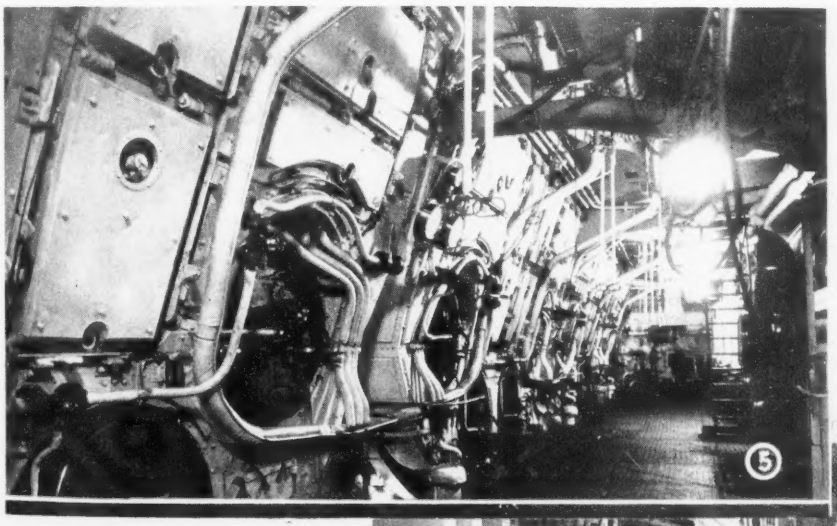
Two of the four 40-pole, 40,000-hp. propelling motors

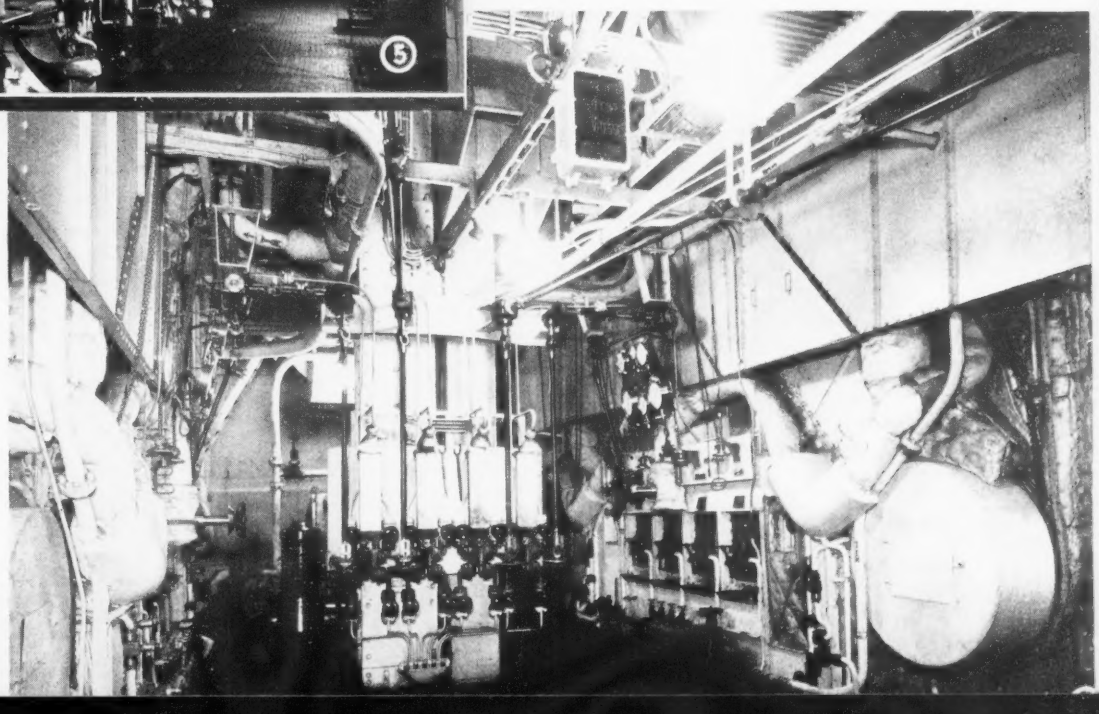


Diagrams courtesy "The Engineer," London. Numbered arrows show photographer's position when correspondingly numbered photographs were taken. Photos by Power

Plan of the four boiler rooms

Weighing 22,000 tons more and 114 ft. longer than the next largest ship, the "Normandie," pride of all France, is only 17 ft. shorter than the 77-story Chrysler Bldg., New York. She made 29.98 knots on her maiden voyage, 30.31 on the return, yet can stop in three lengths. Super-streamlined in hull and superstructure, her fuel economy is excellent—on her trials she burned at 28 knots only as much oil as the 43,500-ton "Ile de France" does at 23 knots. England's "Queen Mary" will be smaller, but more powerful. Normandie's hull contains 11,000,000 rivets and much welding

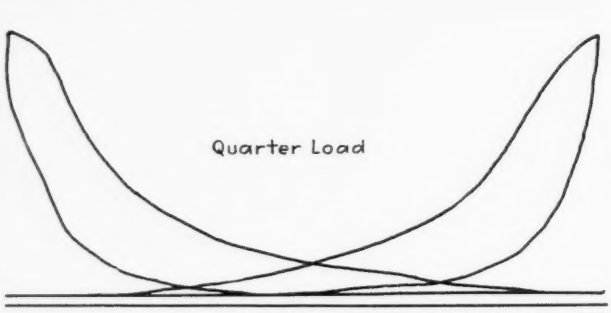


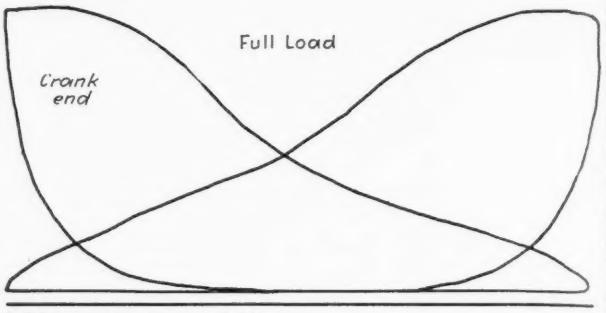


BOILERS—Right, two of the 29 main oil-fired Penhoët, 3-drum, V-type, water-tube units operating at 400 lb. and 680 deg. F. Large drum 63 in. in dia., small drums 39¾ in. Superheater tubes between main tube nests; tubular air heaters at top. Glass-silk lagging. 4 burners per boiler. Four Scotch auxiliary boilers (above) furnish 142-lb. service steam

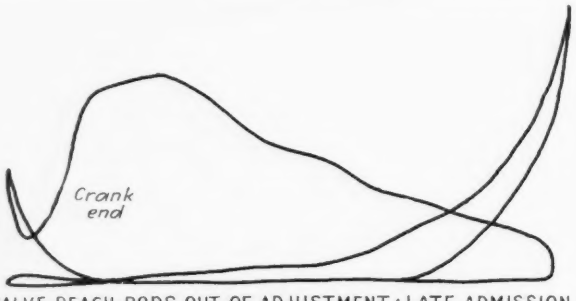
Number 35

Indicator Diagrams—Non-releasing 4-Valve Engine



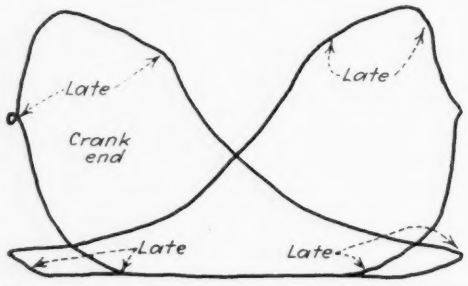


NORMAL ENGINE DIAGRAMS AT QUARTER AND FULL LOAD

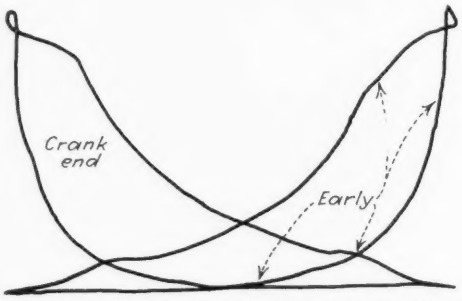


VALVE REACH RODS OUT OF ADJUSTMENT; LATE ADMISSION AND CUTOFF ON CRANK END

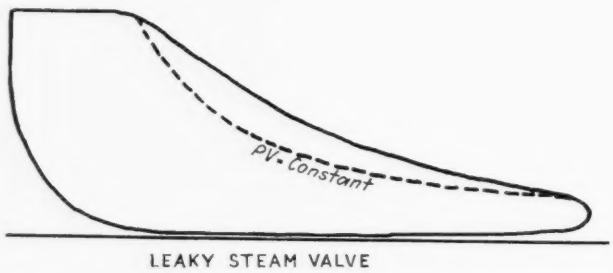
LATE ADMISSION WITHOUT COMPRESSION; LATE RELEASE



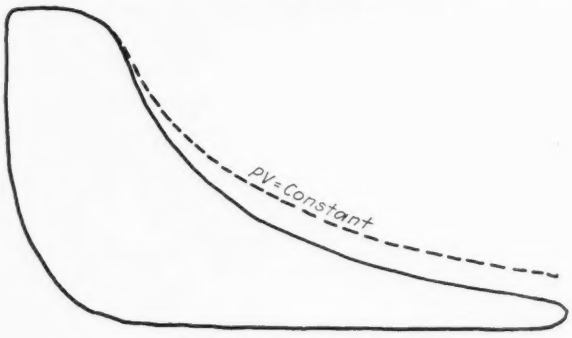
ALL EVENTS LATE; CORRECTED BY ADJUSTING VALVE RODS



ALL EVENTS EARLY; CORRECTED BY ADJUSTING VALVE RODS

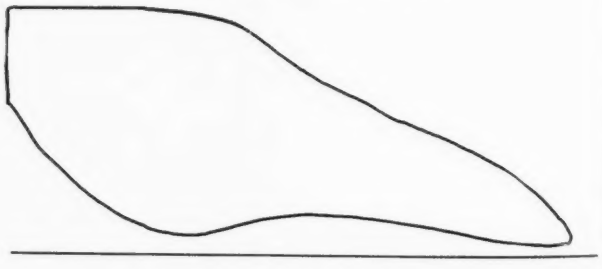


LEAKY STEAM VALVE



LEAKY EXHAUST VALVE

LATE RELEASE

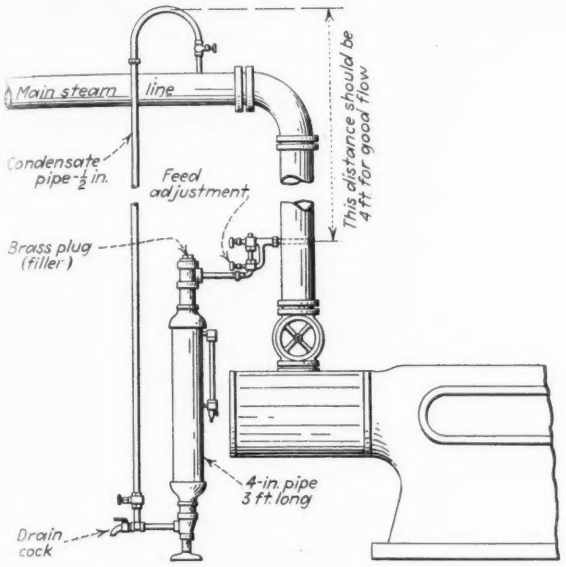


RESTRICTED EXHAUST LINE

Diagrams courtesy Elliott Co.

© POWER

PRACTICAL AIDS TO OPERATION



Built Hydrostatic Lubricator From Pipe and Fittings

THE figure shows a hydrostatic lubricator that I constructed from pipe fittings. For the lubricator body a 3-ft. length of 4-in. pipe, with a 4-in. to 2-in. reducer on each end, was used. The feeder is a No. 494 Lunkenheimer. This lubricator can be used for two or more engine cylinders operating at the same pressure, provided they are fairly close together and an independent feeder is used for each cylinder. After filling and before putting the lubricator into service, give the steam time to condense in the ½-in. pipe connecting the steam main with the bottom of the oil reservoir.

Milwaukee, Wis. L. M. LARSON

Defective Connections Cause Trouble

AT AN industrial plant having a connected load of 4,000 hp., practice for several years was to solder joints only in large conductors. After a period of operation, some of these joints began to give trouble. A 25-hp. wound-rotor induction motor ran hot and below normal speed. Its load had not been increased so we assumed the trouble was in the rotor circuit. When we opened a junction box at the controller, we found the insulation burned off several splices. Careful cleaning and soldering of these splices restored motor performance to normal.

When lighting feeders were revamped, unsoldered splices were found so badly burned that conductor area had been materially reduced. These joints proved to be the cause of flickering lamps. One conductor at the main switch of a 240-kva., 2,200-volt generator was found loose in its lug because the lug interior had not been tinned before soldering. The solder merely acted as a filler about the conductor. We found that all six lugs had been soldered in the same way.

In a large hydro-electric plant, the paint odor of hot insulation led to our detecting a hot terminal lug on a 1,200-amp., 11-kv. oil circuit breaker. The inner layers of taping were found charred and the solder had melted, but lug position prevented the solder from flowing away.

Following a severe system disturbance, pieces of varnished-cambric tape that showed evidence of high temperature were found in the box frame of a large waterwheel generator. Inspection disclosed a defective riveted-soldered joint between field coils. This joint, composed of laminated copper, was partly burned away, and all traces of tinning had disappeared. The fiber insulating collars were also burned near the hot splice. Although two field coils were affected, it was possible to repair one without removing it from the rotor. The other coil had to be replaced with a spare.

In this station, field-coil connections were inspected monthly. An inspection opening was provided in the generator end housing, and by small auxiliary nozzles on the waterwheel the rotor was moved to bring the connections into view. Due to the insulation covering, the bad condition of the connection was not detected despite external inspections until failure was imminent.

Defective lug connections have occasionally been found in controllers because of heating arising from poor contact between segments and fingers. Heating from this cause is often great enough to melt the solder. This condition emphasizes the necessity of properly maintaining control and switching equipment.

Oakland, Calif. RALPH BARR GLENN

Tightening Loose Stator Cores

ON TWO recent occasions trouble was experienced with stator iron becoming loose in motor frames. In one case the laminated core twisted and worked loose in the cast-iron frame and allowed the stator to chatter in its frame as load varied. There was plenty of iron behind the core slots, so it was decided to electrically weld the laminated core to the cross ribs of the frame. Before welding, the core had to be placed

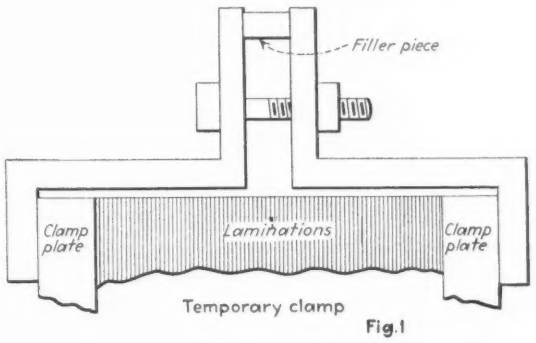


Fig.1

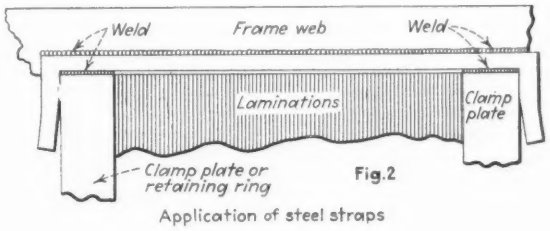


Fig.2
Application of steel straps

concentric with the rotor and bearing end-bells. This was done by winding a 0.020-in. steel wire band on the rotor, which completely filled the air gap between the rotor and stator core. When the machine was assembled, the rotor pulled the stator core into position. Then the end bells were bolted into place. The core was then welded in place by running a bead along the crack between several of the frame ribs and core. The welding short-circuited the laminations but did not cause heating because the welds were on the outside of the core and the windings were not damaged when making the repair.

The second job was more difficult, as it was a larger motor and the laminations had spread. The retaining keys has worked out and allowed the core to become loose and strike the rotor. It was useless to make up new keys, as the same trouble would occur again. Metal straps, with their ends bent over to span the core, were made, Fig. 2. The core was drawn tight with a clamp, Fig. 1, and the strap driven over the core close to a frame rib to which it was electrically welded, Fig. 2. The strap was also welded to the retaining rings but not to the laminations. After the core was tightened at one point the treatment was applied to another. The straps made a permanent repair without damaging the windings.

Toronto, Ont. L. A. HUNT

Defective Primary Lead Causes Noisy Transformer Operation

ONE of our 75-kva., 2,200- to 550-volt transformers developed a peculiar cracking and humming noise, attributed to a loose bolt or laminations. When the transformer was opened and part of the oil drawn off, all connections appeared tight, but one of the primary leads was found loose in its bushing and nearly burned off. When this fault was repaired the transformer went into service and operated quietly. Had the lead burned off and arced to ground, considerable damage would probably have been done to the transformer.

Montreal, Que. J. E. WRIGHT

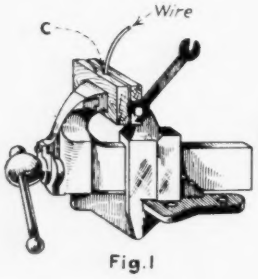


Fig. 1

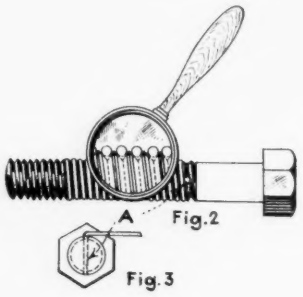


Fig. 2

Fig. 3

Devises Method for Making Spiral Spring

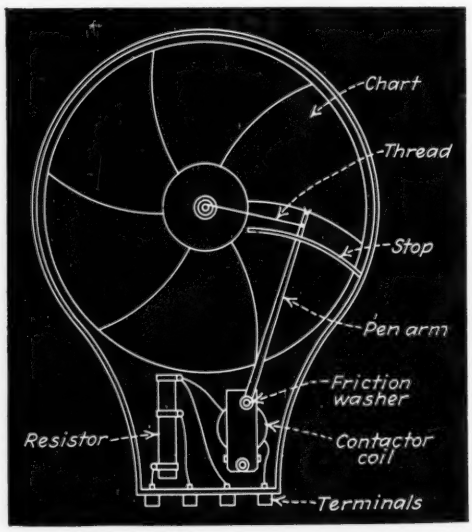
BEING in need of some wire spiral springs and not having a lathe available, I used the method shown in the figures to make them. A long threaded bolt slightly smaller than the springs was secured, and a hole drilled through it, as at *A*, Figs. 2 and 3, of a size to provide a snug fit for the spring wire. The end of the wire was bent at right angles and inserted into the hole. After the bolt was greased, it and the wire was clamped in a vise between two wooden blocks, Fig. 1. By turning the bolt in a direction that backs it out of the blocks the spring wire will wind onto the bolt threads.

The length and finished size of the spring are governed by the pressure maintained on the blocks and the length and size of the bolt. Springs were also made by winding the wire onto a blank rod, in the same manner as when using a bolt. The wire formed a helical shape to expel the rod end-wise as the winding progresses.

Fort Valley, Ga. R. A. HALL

Round-Chart Meter Makes Time Recorder

DISCARDED round-chart recording meters can be easily converted into time recorders to show time of starting and stopping. Replace the pen-operating element with a 15-amp. single-pole contactor, from which the contacts have been removed, as in the figure. The pen arm is retained and attached in such a way that the pen is brought against the chart when the coil is energized, the operation being like that of the printing telegraph. If the pen arm is attached directly to the contactor armature it will be necessary to limit the



motion of the pen by means of a stop in order to prevent splashing of ink from the pen.

Most of these meters are wound when the chart is removed, so that only one-day clocks are provided. However, these clocks will usually run three days and may be rewound with the chart in place if necessary. A record on one chart covering a week or more may be provided for, without overlapping the graph, by pivoting the pen arm so that it can be moved across the chart. The pivot should be placed so that the pen will follow one of the transverse divisions as it is moved.

To move the pen automatically, solder a short piece of $\frac{3}{32}$-in. brass wire, slotted at the end, into a hole drilled axially in the center of the chart-clamping nut. Attach a piece of linen thread knotted at the end to the pen arm and place the other end in the slot. As the chart revolves the thread will be wound around the wire. The graph will then be in the form of a spiral, making its analysis easy. Any chart may be used as the only readings taken are time readings.

The instrument may be made suitable for more than one voltage by using a suitable resistor in series with the coil. The resistor may be placed within the case, connections being

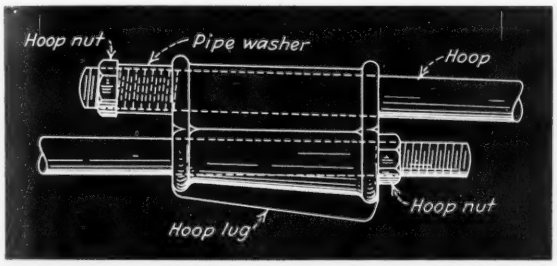
brought out to binding posts marked for the various voltages. Suitable resistors may be obtained in radio parts stores. The taps should be of the adjustable clamp type and should be so placed that the current through the coil is just a little more than sufficient to operate the pen with the voltages available.

Lockport, N. Y. J. G. LATTA

Tightening Large Feed-Water Storage Tanks

SOME time ago it became necessary to tighten the large feed-water storage tanks of our water-softening system, as they were beginning to leak excessively. These tanks are of wood-stave construction about 40,000-gal. capacity. Each of the hoops is made in three segments, thus requiring three lugs per hoop. During fourteen years operation the hoop-stud nuts had been drawn several times and most of the nuts were up as far as the hoop threading would permit.

To tighten the tanks, pieces of pipe large enough to go over the hoop ends were cut 1.5 in. long. The hoop nuts were then removed, one at a time, and one of these pipe washers slipped over the threading onto the hoop against the stud, after which the nuts were replaced and tightened. This



gave the hoop nuts the stave-binding capacity necessary to stop the leaks and provided space on the hoop threads for future tightening.

St. Mary's, O. J. L. YOUNG

Sixteen Tubes Fail in Boiler

IN A plant about four years old, in which boiler feed water was condensate and make-up supplied from evaporators, it was not considered necessary to treat the water. A few tube replacements were necessary. Scale formation was of the hard variety and the tubes were turbined at regular intervals. After following this practice for three years, it was decided to treat the water internally. No more hard scale formed, but there was some soft-mud formation in the lower bank of tubes, which could be easily washed out with a water hose.

For a year after internal water treatment was started there was no tube failure. Although tubes were not turbined, they were clean. Then, one day about one hour after a boiler was placed in operation after being serviced, it developed a leak. It was kept on the line for three hours until another boiler could take its place. When inspection was made the following day, it was found that 16 tubes needed replacement, all in the two bottom rows. Although many theories were advanced, the most plausible explanation for the failures was that dried mud was responsible.

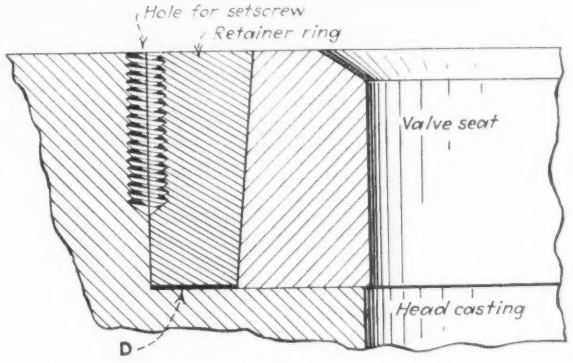
So long as the mud was wet, water could penetrate to the tube, and overheating was impossible but when the mud dried it became a heat insulator like hard scale. Samples of the mud were allowed to air dry. After once dry, if placed in water, they would not soften and the water could not penetrate them. On this particular occasion the mud was not washed, as it was believed it was harmless and there was not much of it. But the boiler remained out of service a longer period than ordinarily, and the mud dried out and became as heat-resisting as hard scale.

Chicago, Ill. N. T. PEF

Tightens Gas-Engine Exhaust-Valve Seat

ONE cylinder on one unit of a battery of natural-gas engines suddenly began losing power through some cause not readily discovered by applying the usual checks. On dismantling, the unusual cause of the trouble was found, as well as the explanation of why it had failed to show up on the compression test. The exhaust-valve seat, of a special alloy, is held in the cast-iron cylinder head by a ring of soft steel, forced home by hydraulic pressure. This ring had worked loose so that the exhaust-valve seat, instead of being rigidly retained in the head, followed the valve through about half of its strokes. This action cut down the available port area and seriously curtailed the time in which exhaust gases could be voided, and the cylinder developed only part of its rated power.

With few machinist's tools available to make a repair, the problem of getting the engine back on the job in the shortest time called for considerable ingenuity. Due to the comparative thinness of the retaining ring, it was evident that peening it would give temporary relief only. To get a more permanent repair, six ¼-in. holes were drilled and tapped on the line between retaining ring and cylinder head. Seat and ring were



clamped temporarily in place during the work by reinserting the valve and tightening its spring.

After drilling and tapping, the valve and seat assembly were removed, and a thin copper washer *D*, 0.004 in. thick, was cut to fit snugly in the recess bottom and just wide enough to be covered by the retainer ring. Seat and ring were then reassembled in the head casting, the copper washer throwing the half-threads out of alignment by 0.004 in. Thus, when hollow set screws were screwed into the holes they forced the retainer tightly against the base and wedged it against the valve seat. When the cylinder head was pulled recently for the annual overhaul the emergency repair was found to be holding as tightly as when made.

Longview, Texas. ELTON STERRETT

CURRENT COMMENT

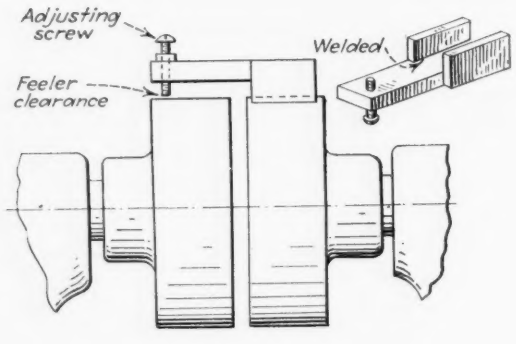
Oil Flash Point and Compressed-Air Explosions

I WOULD like to offer the following comments on the answers to the question on compressed-air explosions in June. While records show that air-compressor explosions can and do occur, they are infrequent and are the exception rather than the rule. The explanation that the cylinder-lubricating oil has too low a flashpoint will not bear close scrutiny as the cause of explosions. It is my opinion that lubricating-oil flashpoint is of little importance, and that some faulty condition of operation or installation must be present in every air-compressor explosion. When explosions have occurred, the operating temperatures are always above the flashpoint of any oil. Tests made of an oil at atmospheric pressure and normal temperatures means little when subjected to temperatures, pressures and possibly dirt and moisture found in air compressors.

In pipelines and receivers where explosions usually occur and oil has been deposited and oxidized, it was put there by the scouring action of the air over which oil flashpoint has no control. Obviously, the viscosity of the air compressor oil should be given more attention than its flashpoint. If the oil's viscosity is too low at operating temperature it easily works past the piston rings and fails to maintain a suitable seal. Too heavy an oil might produce gummy deposits that would bind the piston rings, cause valves to leak, and carbon deposits. The latter could result in an explosion should they be rendered incandescent, irrespective of lubricating-oil flash and fire points.

I believe air-compressor explosions can be eliminated by proper installation; proper maintenance, including a clean supply of intake air and adequate cooling-water circulation; use of correct oil applied in correct amounts; and operation of the compressor under conditions and in the service for which it was designed.

Kingsport, Tenn. B. E. LINGAR
Steam-Turbine Engineer



Aligning Motor-Generator With Rotors in Place

I WAS very much interested in the answers to the questions on aligning a motor-generator in the May number and would like to submit my method of doing the job. The bearings of motor-generator sets may be checked for alignment with the rotors in place providing the shafts are not bent and the bearings worn out of round. If these conditions exist they must be corrected before any accurate check can be made of alignment.

A simple tool used in many plants for checking bearing alignment at the couplings is shown in the figure. It may be made by milling from a solid block or by welding two pieces of $\frac{1}{4}$- x $1\frac{1}{4}$- x $2\frac{1}{2}$-in. steel to a piece of $\frac{1}{2}$- x 2- x $5\frac{1}{2}$-in. steel which has a hole tapped $\frac{1}{2}$ in. from the long end for a $\frac{1}{4}$- x $1\frac{1}{2}$-in. bolt with a locknut to serve as a gage pin and adjustable for different size couplings. This coupling gage replaces the steel straightedge sometimes used. It has the advantage of being easily kept parallel to the axis of the shaft. It may be made of a suitable size for different machine applications. The check is made at points on the coupling 90 deg. apart.

Waynesboro, Va. J. M. MYERS

Boiler Tubes Replaced in Two Parts

YES, boiler tubes have been replaced in two parts, as mentioned by several readers in recent numbers of *Power*. I have seen an h.t. boiler, about 42 in. x 15 ft., in New York, N. Y., with a complete set of tubes in two parts. Its front was nearly in line with the front building wall, and facing a street area, the wall of which was about 8 ft. from the front of the boiler.

At some time previous to my first visit the boiler had been retubed. The tubes appeared to have been connected by being screwed together with a fine thread. This boiler supplied steam to a corliss engine.

Fire-tube boiler tubes in correct practice are beaded at the combustion chamber end, and should be slightly flared at the front end. About 23 years ago the front tube plate drew away from the tubes of a boiler in New York. Had the tubes been flared at the front end, this would not have happened.

Brooklyn, N. Y. GEORGE H. ASHMORE

Frequency of Explosions Has Been Reduced

COMPRESSED-AIR fires are not so common now as they were a few years ago, due to education of plant operators, better lubricating oils and better machines. Present-day machines have valves constructed of light-weight material, giving maximum opening easily and quickly. They also stay tight over long periods of continued use.

Many years ago when air-pipe fires were common, it was the general practice to fit the discharge pipe and sometimes the receiver with a water or steam connection so that in case of a fire, it could be quickly smothered.

By installing modern machines, piping the suction inlet to a clean supply of air; having an ample supply of cool, clean cooling water, using sparingly the best grade of lubricating oil, using intercoolers and aftercoolers, and inspecting equipment periodically, you will reduce to a minimum the possibility of compressed-air fires.

Stratford, Conn. M. C. NYE

Don't Figure Old Equipment

THAT question of whether the book value of old equipment enters into the calculation when computing the returns on an investment in new equipment can best be illustrated by an example:

Assume $10,000 as the installed cost of a piece of new equipment.

Annual operating expense saved by new equipment, $3,000.

Economic life of new equipment, 10 years.

Then at the end of $3\frac{1}{3}$ years the investment has been returned and the company owns a piece of equipment worth $6,667 as part of a going concern.

At the end of 10 years the account would stand as follows:

Inventory value of new equipment	0
Operating expense saved	$30,000
Cost of new equipment to be deducted from savings	10,000
Net savings due to new equipment	20,000
Average net annual return	2,000
Average yearly return in percentage on investment	20%

The $20,000 would not be in the bank, no doubt, but if part of it had been given away in the form of reduced prices and thus enabled the firm to stay in business, the actual returns would be as indicated.

Yearly expenses should include interest on the new equipment but not on the old, as its cost is money spent beyond recovery.

The above is a rational method of computing the value of new equipment, but no doubt few accountants would agree that it is correct and could give a long list of reasons as to why it is not.

Florence, Ky. IRA A. BUTCHER

More on Centrifuging

We were interested in Question 2 by J. J. K., "Centrifuging Diesel Lubricants," (April, page 212) and the answer in June. Our further suggestions we hope will be of interest and service. We advise centrifuging lubricating oil on a continuous bypass arrangement on the basis of 1 hr. for each 10 hr. of operation. It is suggested that 2 to 3 gal. of water per 100 gal. of oil be added every 100 hr. and then centrifuged.

The temperature of the oil as it is fed to the centrifuge should be about 140 deg. F. Pre-settling the oil will do no good except cut down on the labor required for cleaning the centrifuge bowl.

Philadelphia, Pa. C. C. MYERS
Sharples Specialty Co.

Balance Savings and New Investment

NEW equipment replacing existing equipment "is a good investment if the savings in operating cost will yield an adequate return on the new investment." If not why not?

Operating cost as commonly accepted does not include capital charges or return on investment. Capital charges must be paid whether or not equipment is in operation and are fixed by the original investment and time of amortization allowed.

Assume present equipment is to be replaced by new equipment before it is completely amortized, then:

1. Present total costs will include present operating cost plus capital charges on present equipment.

2. New total costs would include capital charges on present equipment (these must be paid until amortization is completed even if equipment is scrapped), plus new operating cost, plus capital charges on new equipment.

Thus capital charges on present equipment are included in both present and new costs.

If then, the saving in operating cost by replacing existing equipment with new equipment will more than pay the total capital charges on the new equipment (these should of course be sufficient to amortize the investment for the new equipment in much less than its expected economic useful life) it will reduce the total costs (i.e. operating costs and capital charges). Is not this the final answer?

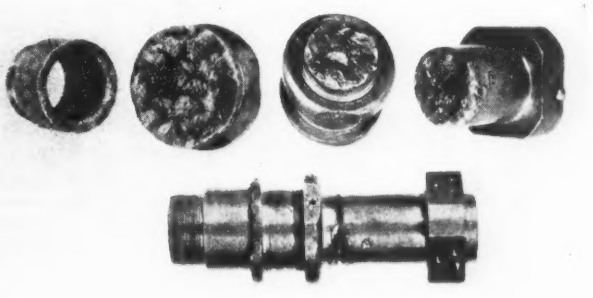
New Haven, Conn. WILLIAM W. GAYLORD

Circuit-Breaker Contacts Stand Severe Service

IN THE May number there appeared in the Readers' Problems section a question and a number of answers regarding rebuilding oil circuit-breaker contacts. There seems to be some possibility that such contacts are redressed and at times rebuilt, when in reality there are many more useful operations left in them just as they are.

In modern oil circuit breakers having butt contacts held together under comparatively high pressure, actual contact at a number of points is sufficient to produce a joint which will carry rated current within the allowable temperature-rise limits. A rather rough and badly pitted appearing contact is often capable of good service, and it may not be necessary to redress or discard it until after considerable metal has been burned away and proper pressure is no longer obtainable.

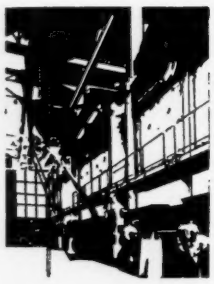
As an example, the photo shows contacts removed from a 115,000-volt, 600-amp., oil-blast breaker after it had interrupted 34 short circuits in actual service in the Cabot station of the Turners Falls Power & Electric Co. Most of these short circuits came in such rapid succession during a sleet



storm that there was no time for inspection between operations. Some time later the contacts were removed and sent to the manufacturer with a question as to whether they could be redressed for further use. Heat run tests were made on them just as received, and showed that they were capable of carrying 1,200 amp. without exceeding the allowable temperature rise of 30 deg. C. This is double the current rating of the breaker in which the contacts were installed. Thus these contacts require no redressing and are satisfactory for further operation.

Philadelphia, Pa. E. H. BECKERT
General Electric Company

READERS' PROBLEMS



QUESTIONS for Our Readers

Water in Power Conduits

Question 1

WE HAVE *experienced trouble with water in long power circuit conduits on gravel roofs. The water seems to be due to condensation. Days are commonly warm and bright, with cold, damp nights. Two remedies have been proposed. One is to drill ¼-in. holes at all low points, particularly in conduit fittings. These holes will serve as drains, and it is claimed they will also reduce condensation. The other method is to seal the conduit ends with insulating compound to prevent breathing that now can occur. These conduits are watertight, therefore rain cannot enter. Probably some* POWER *readers have solved such problems and will give others the benefit of their experience.*—R.B.G.

Water for Sluicing Ash

Question 2

ASH *from our pulverized-coal-fired boilers is sluiced out to a pit. The centrifugal pump which supplies sluicing water is driven at constant speed by a squirrel-cage motor and has a rated capacity of 600 g.p.m. at 250-ft. head. It has seemed to us that more water is being used for sluicing than necessary. As the pump is driven by a constant-speed motor, we can reduce the discharge only by throttling either the discharge or suction of the pump. Will this reduce power required by the pump? If so, will we get a greater reduction by throttling the suction or the discharge?* —G.P.S.

Suitable answers to these questions from readers will be paid for if space is available for their publication.

Jumping of Direct-Acting Steam Pump

WE HAVE *a 6 x 4 in. duplex feed pump the pistons of which make a short jump at the beginning of each stroke. What causes this and can it be prevented?*—F.D.S.

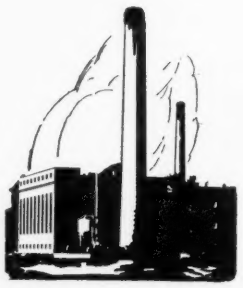
Jumping of the piston is probably due to the presence of air that has been liberated from the water during suction strokes and lodged in pockets of the pump chamber or passages, often adhering to the surfaces so firmly that it cannot be removed except by heating or brushing off. Such films of air are repeatedly compressed and re-expand at every stroke, causing the pistons to begin strokes with a jump when the steam valves reverse. The trouble is more likely to occur with a high suction lift or contracted suction, or from allowing the pump to race when starting up. In a well-designed pump in which there are no pockets like air chambers, the air usually can be removed by warming the water end of the pump with steam from a hose and running the pump slowly for a while with the air vent on the top of the air chamber open and discharge line opened at the atmosphere at only a sufficient elevation to keep the pump chamber flooded.

DOES A TRAP CONSUME STEAM?

ANSWERS to June Question 1

The Question

OUR *plant has two separating traps which receive steam and condensate at 125 lb. pressure. Each trap discharges to an open heater operating at 5 lb. back-pressure. The heater is below the traps. It is proposed to run the condensate discharged from the traps to a closed boiler-feed system using a return trap. The separating traps will then have to discharge to a receiver 30 ft. above them. The receiver of the return trap is to be kept at a pressure of 50 lb. during the filling period. Will it take more steam to push the water up 30 ft. to the closed boiler-feed system than it does to the heater below the trap?*—R.E.P.



Steam Consumption of Trap Is Negligible

STEAM consumption of steam traps is so small as to be practically negligible—in fact, manufacturers state that there is no steam consumption.

Consider the surface of the water to be discharged as a piston acted upon by steam pressure of 125 lb. and, for purposes of calculation, assume the amount of discharge to be 1 cu.ft. of water. Then, power expended in discharging the trap will be equal to the product of effective pressure, volume of water displaced, and time during which the steam acts. Effective pressure under present operating conditions is 125 — 5 = 120 lb.; the work done is 120 ft.-lb. The effective pressure under proposed operating conditions will be 125 —(50 + 13) = 62 lb.; the work done is 62 ft.-lb. (Pressure due to a head of 30 ft. of water is 13 lb. per sq.in.) Capacity varies directly as the effective pressure and the time for discharge varies inversely as the effective pressure. Therefore, the 62 ft.-lb. will act for a longer time than the 120 ft.-lb.

Total energy expended in each case will be the same and thus steam consumed will not change. It has been assumed that the temperature conditions in the trap for both conditions remain constant.

New York, N. Y. MILTON N. KRAUS

No Difference in Steam Consumption

A STEAM trap is a reservoir for collecting the condensed moisture from a steam line or from a system of steam lines. The trap is usually located at the low point of the system so that all condensate will drain into it by gravity. In its simplest form the trap may be conceived as a vessel containing 1 cu.ft. The condensate gradually fills the vessel as may be seen by the water gauge glass on its side. When the vessel is full the valve at the bottom may be opened and condensate discharged either to the atmosphere or to a feedwater heater. As the condensate is usually pure, distilled water, it would be a shame to waste the water especially when an otherwise pure water supply for the boilers is not available.

The "lift of the trap depends entirely on the steam pressure of the line served by the trap. It is usually figured that a trap will lift 2 ft. per lb. of line pressure. If the steam pressure in the line is, for instance, 120 lb. and the lift 30 ft., the trap would still be capable of discharging its contents into a pressure vessel of not over 105 lb. per sq.in. internal pressure. Steam consumption is one cubic foot of steam for each discharge plus the extra condensation due to exposed surface of the trap and drain line leading into it. This latter loss can be minimized by insulating the line and the trap. There is theoretically no appreciable difference in steam consumption between a lifting trap and one discharging by gravity.

Commercial steam traps differ from the one above described in that opening and closing of the trap discharge valve is done automatically. Should the trap be defective and discharge valve not close tightly steam may leak and thus increase consumption.

Pittsburgh, Pa. BERNARD KRAMER

DEGREE-DAY AND WIND VELOCITY

ANSWERS to June Question 2

The Question

FOR *some years it has been customary to estimate building heating requirements on a degree-day basis. I have been told recently that wind velocity is also an important factor and one not considered in normal estimating. How much effect does wind velocity have? Is it worth considering? Where can I get data on its effects and how to design for them, if it is necessary?*—E.N.R.

Wind Affects Heat Transmission

IF WIND velocity is not included in a heat loss computation I consider the result a very rough estimate. Some engineers are of the opinion that so many assumptions have been used already it would not affect the result materially if the effect of wind velocity was assumed negligible. But they fail to consider two things:

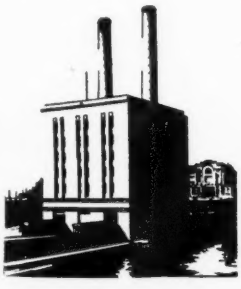
(a) That the transmission of heat through the walls, glass and roofs of a building or structure is dependent upon wind velocity; an increase of wind movement resulting in an increase in heat transmission. This factor affects poor (old) buildings to a greater degree than buildings which are new and have walls built of good materials.

(b) That the leakage of cold air through the door and window cracks and through porous building materials is increased materially with an increase in wind velocity.

When computing the above two factors the average wind movement during the three coldest months (Dec., Jan. and Feb.) should be used for the locality where the building is being erected. A fair assumption to make for any locality when specific data is not available, is 15 miles per hour for the average wind velocity. Tables are available which give average wind velocities for specific months for various U. S. cities.

The following compares (a) coefficients of transmission, and (b) air leakage, for materials in stall air and in air at 15 miles per hour.

(a) A plain 4-in. common brick wall without plaster has a coefficient of transmission of



0.5 B.t.u. per hr. per sq.ft. per deg. difference in temperature between the air on the two sides, based on *NO* wind on both sides.

But, on the other hand, a plain, uninsulated brick wall having no interior finish but based on a wind velocity of 15 miles per hour requires 8 in. of brick (4-in. of face brick and 4 in. of common brick) to give the same coefficient. Thus to give the same coefficient of heat transmission requires a double thickness of brick if a 15 mile wind is assumed instead of still air.

(b) The air leakage through a plain 8½ in. brick wall (porous brick and mortar) is 0 in still air and about 7.8 cu.ft. per sq.ft. per hr. at a wind velocity of 15 miles per hr. Of course this would be materially reduced by plastering. Different types of materials have different values also.

The above indicate the effect of wind velocity and I am leaving it up to E. N. R. to decide whether it is worth considering. It is, however, good engineering practice to include it in the heat loss calculations. If he is undecided I would advise he make two computations one with still air and another with 15 mile wind and let his future practice be governed by his findings.

More data on wind velocity and heat loss computations may be found in ASHVE transactions Vol. 36-1930 under "Surface Conductances as Affected by Air Velocity, Temperature and Character of Surface" and "Air Infiltration Through Various Types of Brick Wall Construction."

Woodcliffe, N. J. K. B. HOFFMAN

B.t.u. per Cubic Foot of Room Contents for Zero Outside Temperature

No. of air changes	Final Temperatures, Deg. F. 40	50	60	70	80
1	0.763	0.935	1.100	1.260	1.411
1½	1.144	1.402	1.650	1.890	2.116
2	1.526	1.870	2.200	2.520	2.822
3	2.289	2.805	3.300	3.780	4.233

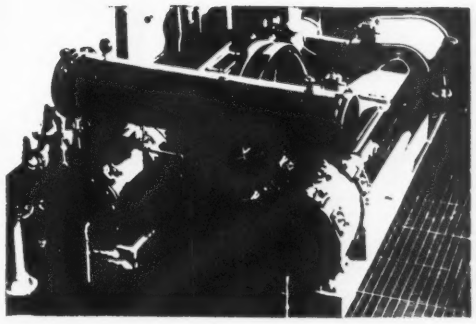
No Fixed Rule to Allow for Wind

E.N.R. ASKS about the effect of wind velocity in calculating heating requirements for buildings. If there is any fixed rule for this I have not seen it. Type of construction, varying wind velocities and exposure make it just about impossible to set up any definite rule or formula.

Therefore this part of calculating heating requirements is based on the amount of air infiltration into a space to be heated, and is worked out on the times per hour that the air content of a space will be changed.

Naturally air infiltration will increase with wind velocity, and considering wind velocity to be expected and the chances for air infiltration through cracks and loose construction, it seems to be a matter of estimating the number of probable air changes per hour. Then, knowing the outside air temperataure and the temperature to be maintained inside, it is a simple matter to calculate the heat loss due to air infiltration.

The accompanying table gives factors by which the volume of a space in cubic feet may be multiplied to determine the heat loss through a range of one to three air changes per hour, for inside temperature of 40, 50, 60, 70 and 80 deg. This table is taken from a handbook of the New Jersey Gas Association, known as "Engineering Handbook for Building Heating By Gas."



Some of the formulas for calculating heat loss by transmission through walls, windows, etc., assume a wind velocity of 15 miles per hour. Possibly this may not apply to all formulas, but it is evident that wind velocity has a bearing on this as well as on air infiltration.

Elmira, N. Y. H. L. STRONG

Allow 10-20%

THE effects of wind velocity upon heat losses through the walls and roofs of buildings are generally neglected in most ordinary calculations of building heating requirements. Ordinarily the estimates of building heating requirements are based upon the difference in temperature between inside and outside air together with the coefficient of heat transmission through the structure and number of air changes per hour within the building due to infiltration or direct ventilation. Heat transmission losses depend upon the type of materials and construction used. Infiltration pertains to leakage around doors and windows and is usually assumed to amount to so many changes per hour depending upon conditions.

While it is customary when computing heating requirements to use a temperature of 10 deg. above the lowest recorded temperature for the outside temperature, neglecting any effects of wind, it is obvious that wind may have a decided effect upon the fuel consumption in maintaining a comfortable temperature within the building.

It is a difficult matter to assign any actual value to the effects of wind on heat losses in buildings because of the diverse influences of different wind velocities together with other factors bearing directly upon the losses, because the situation or location of a building may afford protection against prevailing winds. And it may also be said that winds are exceptions rather than ruling factors governing heat losses in most instances, except where buildings are so located as to be exposed to high winds.

Thus wind velocity may in some cases be an important factor worth considering, but in a majority of heating requirement calculations it may be regarded as of minor importance and neglected. It is recommended, when computing heat losses of buildings exposed to wind, such as those located in open areas or the upper stories of high buildings, that the losses computed in the regular ordinary manner be increased from 10 to 20% to allow for the effects of wind.

St. Mary's, Ohio J. L. YOUNG

MANUFACTURER'S BULLETINS

(Additional bulletins on page 456)

Air Conditioning—Buffalo Forge Co., Buffalo, N. Y. Bulletin No. 2967, 12 pages, containing ratings, dimensions and illustrations of cooling and air-conditioning units.

Bearings—Bearing Appliance Co., Ardmore, Pa. 9 data sheets showing detailed dimensions of finished, ready-to-use appliances for ball and roller bearings.

Bearings — Timken Roller Bearing Co., Canton, Ohio. 260 loose-leaf pages bound in a 3-ring binder with stiff covers. Discusses design, operating characteristics, applications and methods of mounting bearings.

Boilers — Combustion Engineering Co., Inc., 200 Madison Ave., N. Y. General specifications HT-10 for h.r.t. boilers gives descriptions and structural details. Shows both riveted and fusion-welded construction for the shells, various details of the boilers, grate breechings, etc., as well as general information on settings.

Boiler Accessories—McDonnell & Miller, Wrigley Building, Chicago, Ill. 24-page catalog on accessories for boiler water-level control. Contains descriptions, dimensional drawings, capacity charts and wiring diagrams.

Bucket Elevators—Jeffrey Mfg. Co., Columbus, Ohio. Catalog No. 565, 112 pages, covering the fundamentals of design, application and operation of bucket elevators.

Condensate Pumps — Roots-Connersville Blower Corp., Connersville, Ind. Bulletin 260-B14 covers condensate units intended for heating systems and boiler-feed service for sizes between 2,000 and 70,000 sq.ft. of radiation.

Conveyors—Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill. Folder No. 1414 covers a line of portable belt conveyors.

Dust Removal—U. S. Hoffman Machinery Corp., 105 Fourth Ave., N. Y. 16-page folder on the menace and removal of dust. Illustrations show equipment, methods and typical installations.

Electric Equipment — Diehl Mfg. Co., Elizabethport, N. J. Price list and Catalog No. 35 of electric motors, generators and ventilating equipment. Gives operating characteristics, sizes, uses and prices.

Fans—Trane Co., La Crosse, Wis. 24-page bulletin showing construction, capacities and structural specifications for centrifugal fans. Also illustrates dimensions and standard arrangements.

Gas-Oil Engines — Worthington Pump and Machinery Corp., Harrison, N. J. 8-page bulletin giving specifications, construction and general data on horizontal, 2-cycle, oil-field engines.

Governors — Woodward Governor Co., Rockford, Ill. Bulletin describing governors for various types of prime movers.

Impact Wrenches—Ingersoll Rand Co., 11 Broadway, N. Y. 16-page leaflet describing uses and sizes of compressed-air wrenches.

Instruments — Weston Electrical Instrument Corp., Newark, N. Y. 8-page bulletin describing panel-type electrical measuring instruments, including specifications, dimensional drawings, illustrations and prices.

Instruments—Pyrometer Instrument Co., 103 Lafayette St., N. Y. Bulletin No. 60 illustrates and describes surface pyrometers.

Lighting Equipment—Benjamin Electric Mfg. Co., Des Plaines, Ill. Catalog 26, 288 pages of complete listings, illustrations, descriptive material and engineering data on reflectors, lighting equipment, floodlights, fittings and signals.

Lubricating Equipment—Gits Bros. Mfg. Co., 1846 Kilbourne Ave., Chicago, Ill. 144-page general catalog, No. 50, listing oil gages, oil and grease cups, wick-feed oil cups, constant-level oilers, automatic multiple oilers, oil and grease seals and a large variety of other lubricating devices.

Motors—Allis-Chalmers Mfg. Co., Milwaukee, Wis. Two leaflets, No. 2100 describing wound-rotor induction motors and No. 2183 on "Type E direct-current motors and generators."

Motors—Allis-Chalmers Mfg. Co., Milwaukee, Wis. Cut-out booklet graphically illustrating a "quick-clean" motor available in 5-, 7½-, 10- and 15-hp. sizes. Shows internal construction and mounting dimensions also.

Motors—Louis Allis Co., Milwaukee, Wis. Bulletin No. 601 deals with the special characteristics and containing other important information regarding electric motors for centrifugals.

Meters — Foxboro Co., Foxboro, Mass. Bulletin No. 200, 48 pages, entitled "Meters for Steam—Liquids—Gas" contains information on flow engineering and measurement. The booklet also describes a universal flowmeter used to measure steam, water, air, oil, gas and all kinds of chemical solutions.

Mine Pumps—Byron Jackson Co., Bethlehem, Pa. Bulletin No. 359, 12 pages, gives information useful in the selection of equipment for mine pumping. Illustrations show construction and list parts of each pump.

Non-Ferrous Metals—Nassau Smelting & Refining Co., 50 Church St., N. Y. 12-page magazine, published monthly, contains news and editorials for users of non-ferrous metals.

Oiling Devices—Wm. W. Nugent & Co., 410 N. Hermitage Ave., Chicago, Ill. Bulletin 00, Edition 2, composed of five bulletins containing information on all types of accessories for lubricating systems.

Piping Systems—Tube-Turns, Inc., 725 S. 5th St., Louisville, Ky. Bulletin discussing design of modern industrial piping systems and a method for determning the most economical pipe sizes by means of included charts.

Pneumatic Equipment—C. A. Norgren Co., Inc., Denver, Colo. Catalog No. 100, 20 pages, gives description and prices of accessories for compressed-air systems.

Pipe Flanges — Taylor Forge & Pipe Works, P. O. Box 485, Chicago, Ill. Catalog 35, 96 pages. A "text-book" of information and specifications for forged-steel pipe flanges and seamless welding fittings.

Pumps—Worthington Pump & Machinery Corp., Harrison, N. J. 4-page folder gives specifications and list of parts for Type U 2-stage volute centrifugal pumps.

Radiators—Shaw-Perkins Mfg. Co., Pittsburgh, Pa. 20-page bulletin showing convector radiators for residential, commercial, industrial and marine heating systems.

Steam Distribution — American District Steam Co., North Tonawanda, N. Y. General Catalog No. 31 listing equipment for steam distribution and data for the selection of proper sizes.

Suction Pumps — Lawrence Machine & Pump Corp., 371 Market St., Lawrence, Mass. Bulletin 202 describes standard side-suction centrifugal pumps and their application. Contains tables showing range of capacities and heads for different sizes.

Tube Benders — Parker Appliance Co., Cleveland, Ohio. Bulletin No. 39 gives descriptions, instructions, lists of parts and prices for production tube benders.

Valve Indicators — Tefft-Jackson, Inc., 830 Hospital Trust Bldg., Providence, R. I. 4-page folder shows models and specifications for valve-position indicators.

Wood Preservation—Tennessee Eastman Corp., Kingsport, Tenn. 16-page booklet dealing with protection of wood against decay, dry-rot and termites.

Valves — Automatic Switch Co., 154 Grand St., N. Y. Catalog giving specifications, general service recommendations, and prices on solenoid-operated valves for automatic and remote control. Also illustrates magnetic switches and relays.

Valves — Jenkins Bros., 80 White St., N. Y. Three circulars, No. 159 on regrinding iron-body gate valves, No. 160 on twin-bolt gate valves and No. 162 on bronze gate valves.

Welders — Ideal Electric & Mfg. Co., Mansfield, Ohio. Bulletin 910, 16 pages, describes in detail the "Speed-Arc" welder, giving structural details and operating characteristics.

Welding Electrodes—Metal & Thermit Corp., 120 Broadway, N. Y. 16-page illustrated booklet showing design, qualities, costs and characteristics of mineral-coated welding electrodes.

White Lead — National Lead Co., 111 Broadway, N. Y. 8-page folder on cost and uses of white lead in painting.

Lightning Arrestors — General Electric Co., Schenectady, N. Y. Bulletin No. GEA-2107 describes equipment for protecting every part of the electric system against lightning.

Lubrication—Standard Oil Co., 910 S. Michigan Ave., Chicago, Ill. Three monographs written by the technical staff containing helpful hints on lubrication in general and for diesels in particular.

Dragline Scrapers—American Hoist & Derrick Co., St. Paul, Minn. Catalog No. 77 covering the Model 350, ½-yard crawler-type shovel-crane-dragline, for gasoline, diesel or electric operation.

Pumps—Allis-Chalmers Mfg. Co., Milwaukee, Wis. Leaflet No. 2201 gives specifications and views of the Type MM multi-stage centrifugal pump.

Circuit Breakers—General Electric Co., Schenectady, N. Y. Bulletin No. GEA-1972 gives the construction features of an oil circuit breaker for 50,000-kva. service.

Lubricant—Tide Water Oil Co., 17 Battery Place, N. Y. A "condensed treatise" on grease. What appears to be a voluminous edition on lubricants turns out to be a box containing a sample of the grease and a few words of explanation.

Dial Indicators — L. S. Starrett Co., Athol, Mass. 24-page booklet giving information about salient parts, construction, specifications and sizes of dial indicators.

Signs—Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh, Pa. 4-page folder illustrates signs for points of danger.

Air Compressors—Worthington Pump & Machinery Corp., Harrison, N. J. 6-page folder gives complete data on 2-stage, vertical-angle, air compressors.

Pumps—Allis-Chalmers Mfg. Co., Milwaukee, Wis. Leaflet No. 2199 illustrates and gives construction details of a universal pumping unit.

Condensers—York Ice Machinery Corp., York, Pa. Three bulletins: (1) Vertical shell-and-tube condenser, single-pass open type. (2) Horizontal shell-and-tube condenser, multi-pass closed type. (3) Horizontal shell and tube brine cooler, multi-pass closed type.

Motors—Century Electric Co., 1806 Pine Street, St. Louis, Mo. 8-page bulletin illustrates squirrel-cage induction motors ranging in size from 1 to 600 hp.

Portable Electric Tools—Black & Decker Mfg. Co., Towson, Md. Silver anniversary catalog illustrating a complete line of portable electric tools with prices, applications and specifications.

Steam Traps — Armstrong Machine Works, Three Rivers, Mich. 28-page catalog, third edition, containing information on the operation, selection, installation and maintenance of steam traps.

Meters—Schutte Koerting Co., Philadelphia, Pa. 12-page bulletin shows in minute detail the integral parts and operation of an electric flowmeter.

Potential Device — General Electric Co., Schenectady, N. Y. Bulletin No. GEA-2096 describes the performance, construction and application of a device used to operate instruments and relays from a high-voltage circuit.

THE ENGINEER'S BOOKSHELF

For the Operating Man

POWER OPERATORS GUIDE (1935)—*Compiled and edited by E. J. Tangerman, Associate editor,* POWER. *Published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y. 568 pages, 6x9 in. 323 diagrams, flexible cloth covers. Price $4.*

This compilation of 1001 practical ideas, methods and tools will save time, labor and money in the power plant and along the line of power services. Selected by the compiler from *Power's* regular department, "Ideas from Practical Men" and its predecessors over the past seven years, these represent the cream of the material published. They are arranged in 19 chapters beginning with fuel-handling and feedwater treatment and going all the way through to electricity, heating and ventilating, refrigeration, compressed air, and mechanical transmission. There are separate chapters on oil and gas engines, hydro, tools, steam engines, steam turbines, pumps, compressors, etc., the number of items in each depending upon the relative importance of the subject to the average *Power* reader.

This is not a "kink" book in the sense that it is only a hundred or so ideas thrown together. It is a carefully sifted compendium of 1001 of the best practical ideas recently published, edited and shortened to retain essential ideas, and copiously illustrated. It is really a power operating engineer's handbook —the first of its kind.

Turbines

STEAM TURBINES *(2nd Edition). By Prof. Ewin F. Church, Polytechnic Institute of Brooklyn. Published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y., 327 pages, 6 x 9 in. Cloth. Illustrated. Price $3.*

Like its first edition, the book is designed primarily as a text book for short college courses in steam turbines. Technically it occupies the middle ground between a purely descriptive or elementary and a highly technical treatise for designers or advanced students.

Revisions in the second edition include replacement of old illustrations by modern material, new information on supersaturation and the flow of wet steam, recalculation of illustrative examples to accord with the Keenan Steam Tables.

Practical Mechanics

PRACTICAL MECHANICS OF MOTION (1935) —*By John F. Mangold, C. E., associate professor of mechanics, Armour Institute of Technology. Published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y. 263 pages, 5 x 8 in. 144 diagrams, 5 tables. Price $2.*

Intended as a sequel to "Practical Mechanics and Strength of Materials" by Leigh & Mangold, this volume endeavors to apply basic theory to many types of practical problems. It is suited to students or engineers with a working knowledge of algebra, geometry and trigonometry and should prove of particular use for trade and evening schools, for college short courses, or for the technical man trying to gain a first-hand knowledge or to review the subject.

The eight chapters are: Rectilinear Motion; Moments of Inertia; Curvilinear Motion; Rotation; Work, Energy; Power (28 pages); Belting, Electrical and Water Power, Machines (12 pages); Impulse, Momentum & Impact. The final three chapters will be of particular interest to power engineers. They are simple and easily readable, and provide that much-required working knowledge of steam, electrical and gas power and how it is figured, measurement of power, horsepower of belting, etc.

Power Rates

FEDERAL POWER COMMISSION ELECTRIC RATE SURVEY. *Separately bound report for each state. Rate Series No. 2. Paper, 9 x 12 in.; average about 8 pages of text, tables and charts. Supt. of Documents, Washington, D. C. Price 5 cents each state report.*

July *Power* (page 389) noted the preliminary report of the Federal Power Commission Electric Survey, Rate Series No. 1. This gave domestic electrical rates for all U. S. cities over 50,000 population.

Each of the individual state reports covers all communities of 250 or more population for which information is available. For each of these the tabulated information includes the monthly bill for 15, 25, 40, 100, 150, 250 and 500 kw.-hr. consumption. In the back are charted the highest and lowest bills for 25, 100 and 250 kw.-hr. in each.

Brief Reviews

LEFAX. *New data sheets for this company's binders. Published by Lefax, Inc., Philadelphia, Pa.*—"Hard Rubber" (8 pages), "4-Place Reciprocals of Numbers," "Squares of Numbers," "Square Roots of Numbers," "Sound-Absorption Coefficients of the More Common Materials."

AIDE CALCUL GRAPHIQUE POUR LA THERMODYNAMIQUE (GRAPHIC CALCULATION HELPS FOR THERMODYNAMICS) 1935. *By Coloman Vargha. Published by Librarie Polytechnique Ch. Béranger, 15 Rue Des Saints-Pères, Paris, France. Loose leaves in board portfolio, 11x16 in. 10 pages of explanation. 28 double-page charts. Price not stated.*—Althought the charts are in the metric system, and in French, they should be very helpful to American engineers whose work involves theoretical gas calculations. The following selected titles give a faint idea of the relations covered by the numerous charts: gas densities at different pressures and temperatures; pressure change in compression; critical pressures and velocities; mechanical energy corresponding to combustion of fuels; theoretical weight of combustion air.

PHYSICAL PROPERTIES OF SPEED PORTLAND AND BLENDED CEMENT MORTARS AND CONCRETES (1935). *By R. E. Mills and R. B. Crepps. Report of an investigation by Engineering Experiment Station, Purdue University. Paper. 56 pages, 6x9 in. Published as Research Bulletin No. 47 of the Station at Lafayette, Ind. Price 50 cents (limited number free)—Extensive data.*

THE METALLURGY OF OXY-ACETYLENE WELDING OF STEEL (1935). *By J. H. Critchett, vice-president, Union Carbide & Carbon Research Laboratories, Inc. Published by Linde Air Products Co., 30 East 42nd St., New York, N. Y.*—Discussion of physical and chemical principles involved in oxy-acetylene welding of steel. Compares metallurgy of open-hearth practice with that of steel welding.

ANNUAL REPORT OF THE SMITHSONIAN INSTITUTION (FOR 1933). *Published by the Institution, Washington, D. C. Paper. 468 pages, 6x9 in. Copies for sale by the Superintendent of Documents, Washington, D. C. Price 70 cents.*—Includes a number of papers, mainly geological and astronomical, but one on high voltage, by Karl T. Compton.

A LIST OF BOOKS AND OTHER SOURCES OF INFORMATION REGARDING COAL AND COAL PRODUCTS. *Compiled by F. R. Wadleigh, consulting engineer. Paper. 63 pages, 6x9 in. Copies available from Mr. Wadleigh at Cecil Apartments, 1026—15th St., N. W., Washington, D. C. Price $1.*—Lengthy bibliography relating to coal and its principal products, including society proceedings, technical institute reports, bulletins, etc.

JS DIAGRAMS FOR COMBUSTION GASES OF RICH MIXTURE (1935). *By Keikichi Tanaka and Seüchi Awano. Report No. 118 of the Aeronautical Research Institute, Tokyo. Imperial University, Japan.*—Total heat-entropy diagrams for gasoline-benzol mixtures with air.

A DISCUSSION OF THERMAL SPALLING OF FIRE-CLAY BRICK WITH RELATION TO YOUNG'S MODULUS OF ELASTICITY, THERMAL EXPANSION AND STRENGTH (1935). *By R. A. Heindel, chief, Refractories Section, National Bureau of Standards. Published by American Refractories Institute. Technical Bulletin No. 58, paper, 8 pages, 6 x 9 in.*

COAL (1935). *By W. H. Young, L. Mann, H. L. Bennit, and F. G. Tryon. Statistical Appendix to Mineral Yearbook, 1934. Published by U. S. Department of Interior, Bureau of Mines. Price 10 cents from Superintendent of Documents, Washington, D. C.* Detailed statistics on all phases of coal.

A. S. T. M.—*Four preprints of meeting papers published by the Amer. Soc. for Testing Materials, 260 S. Broad St., Philadelphia, Pa., which may be of interest to* POWER *readers are:* CONTINUOUS-FLOW CORROSION TESTS OF STEEL PIPE, No. 28; REPORT OF COMMITTEE D-2 ON PETROLEUM PRODUCTS AND LUBRICANTS, No. 58; EFFECT OF VOLATILITY OF OIL CONSUMPTION, No. 71; AND REPORT OF COMMITTEE A-1 ON STEEL, No. 7.

WHAT'S NEW IN PLANT EQUIPMENT

TRAP WITH ONE MOVING PART

EXTENSIVE experimentation produced this steam trap of unique design. Extremely compact, machined entirely of bar stock (steel, Tobin bronze and Monel), it has no thermostatic or float elements. Sole moving part is single Monel metal piece.

Section view below shows features of construction. Parts are steel body *A*, Monel valve and piston *B*, Monel valve seat *C*, bronze cylinder *D* (adjustable up and down through threaded extension and lock nut *E*), bronze bonnet *F*, and bronze seal cap *G*. Valve and piston *B* is free to move up and down, rotate or wobble. Cylinder *D* within which upper piston disk slides is tapered slightly from a tight fit at bottom to loose fit at top.

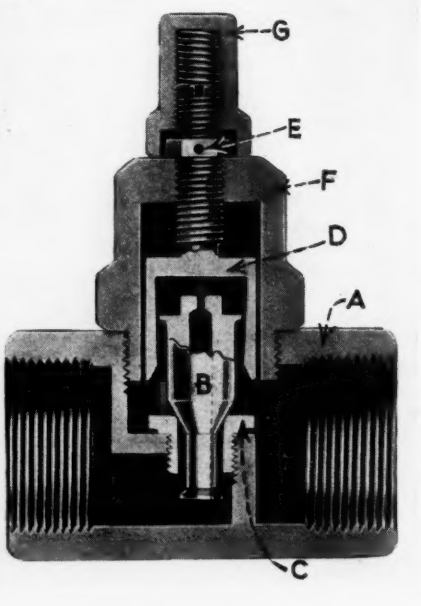
An orifice in top of *B* leads to a large hole running down through bottom extension. Whether valve is open or closed, there is a constant small flow of water from inlet around piston to upper chamber, and then down through this opening to outlet. In operation, valve rises to discharge water rapidly for a while, then closes tightly to eliminate all except small continuous flow through central orifice. Two sets of laws are here involved: those governing flow of fluids through two orifices in series, and those governing flashing of hot water into steam under reduced pressure. First orifice is clearance between piston and cylinder, while second (already described) runs down through valve axis.

Imagine valve open and discharging water against atmospheric pressure at a temperature below 212 deg. Some of flow bypasses through the two orifices.

Temperature is too low for flashing, so law of series orifices holds, first orifice taking a constant percentage of total pressure drop. Initial pressure pushes up on valve, while chamber pressure pushes down, but former acts on a smaller area (about 92% of latter). Thus, when upper pressure is less than 92% of lower, valve is held open. Cylinder clearances are so designed that this pressure relation holds for water at any temperature much below saturation point. When valve closes, lower area decreases so that valve cannot open again until chamber pressure falls to about 86% of initial pressure.

Now picture accumulated and fairly cool water starting to flow rapidly through open valve seat. Temperature naturally rises as accumulation of dead water passes through valve, and that more recently condensed comes to it. A fraction of this flow is continuously bypassed through the orifices.

Finally, temperature is high enough so that flashing begins part way through second orifice. Flashing of part of water into steam has a "choking" effect on second orifice, so that pressure starts to "back up" in chamber. As water gets hotter and hotter, amount of flashing steadily increases, and with it choking effect, so that chamber pressure continues to rise. Finally, it reaches 92% of initial pressure and closes valve again. Water temperature at which this occurs can be controlled by adjusting up-and-down position of cylinder, which in turn adjusts annular clearance that constitutes the first orifice.

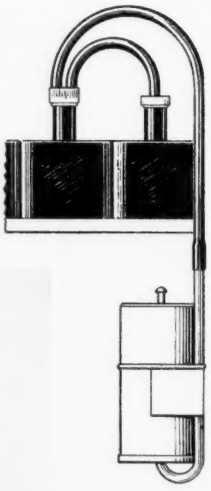


Yarway impulse trap is now made in six sizes: ½ in., ¾ in., 1 in., 1¼ in., 1½ in. and 2 in. But one pattern in each size, making for economy of manufacture and simplicity of stocking and ordering. As factory adjusted, this single pattern is suitable for all steam pressures up to 600 lb., and for a substantial range of back pressures.

Pipe-threaded opening in trap bottom permits insertion of a pet cock to test operation on closed-return systems.

Upper left illustration shows parts of a 1-in. trap. Body length is 3⅛ in., total weight 2½ lb., capacity ranging from 1,360 lb. per hr. at 10 lb. pressure to 4,380 at 600 lb.

Yarnall-Waring Co., Mermaid Ave., Philadelphia, Pa.



AIR BELL FOR ORSAT

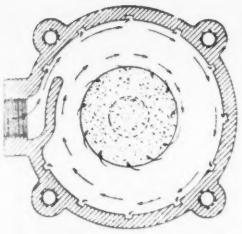
DESIGNED to replace rubber air bag on Orsat gas analyzers, it consists of a floating bell in a cup filled with water up to bead. Weight of bell provides necessary air pressure, which is constant for full range of bell movement, approximately ¾-in. water head for 50-ml.(cc), and 1 in. for the 100-ml. analysers. With this low air pressure, speed of operation is increased beyond that possible with air bags inflating to pressures several inches water head. Before beginning test, and with solutions standing at the rings in capillary tubes, bell is adjusted to stand even with top of cup or up to ⅛-in. above top, by holding bell with one hand and sliding tubing over single-point adapter with the other. To compensate for contraction of air volume in bell by solutions absorbing oxygen, a clearance of ⅜-in. is provided at cup bottom. Cup is held in place by a clip, easily detached for filling and draining water. Bell is connected with solution containers by ⅛-in. bore rubber tubing, for which glycerine (lubricant for rubber) is furnished. Nipple adapters are recessed for rubber gaskets, (additional supply with analyzer). Bell assembly and fittings are brass, nickel plated.

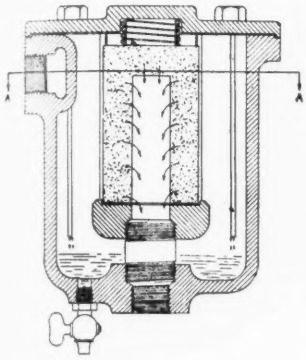
Ellison Draft Gage Co., 214 West Kinzie St., Chicago, Ill.

DIRECT EXPANSION TYPE UNIT COOLER

THESE coolers are designed for installation with a compressor (either air or water-cooled) using Freon, methyl chloride, sulphur dioxide or any other common refrigerant, except carbon dioxide, as cooling medium. Condenser is of continuous copper coil type. Tubes have vertical fins. Fins metallically bonded to tubes to assure non-deteriorating heat transfer from primary to secondary surfaces. Unit equipped with expansion valve in refrigerant supply line, moisture eliminator plate, adjustable air deflector in front. Units also available for operation with ammonia, using steel instead of copper tubing. Unit customarily suspended from ceiling, and not designed for both cooling and heating. Three standard sizes: Model 1960-DE equivalent of approximately one ton on refrigerant temperature of 25 deg., entering air temperature 85 deg. Under similar conditions, Model 4080-DE is equivalent to approximately two tons, Model 6060-DE to three tons. Bulletin 335.

Modine Manufacturing Co., Racine, Wis.





AIR FILTER AND SEPARATOR

ALUMINUM-OXIDE crystals and a ceramic bonding material in tube form vitrified at 2,372 deg. F. are used in combined unit claimed to have porosity equal to 38% of its total material volume. Air is introduced into filter proper through orifice in upper rim of metal casing, and throws off into vertical slots any entrained oil, water, etc., as it circulates. Approaching inner axis of filter it slows down and passes through renewable porous filtering element, open at lower end to permit escape of clean dry air.

R. P. Adams Co., Buffalo, N. Y.

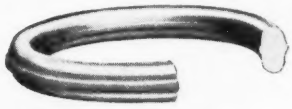
NEON PILOT LIGHT

"INDICATOR TATTELITES" operate on standard commercial voltages (90-250) a.c. or d.c., to tell when electric unit is operating, either directly or in remote control circuits, or to indicate open circuits or switches, blown fuses, etc. Consume about 1/1000 amp. Unaffected by vibration and have 3,000-hour life. Neon bulb used is 1 in. x ¼ in. in diameter, with octagon shaped base, similar to those on switchboard lamps. Dead-front panel type mountings with clear phenolic resin caps are available. Limiting resistor built into mounting. For circuits requiring no resistor, a direct terminal is provided. Designed especially for small space.

Littlefuse Laboratories, 4507 Ravenswood Ave., Chicago, Ill.

FORGED IRON RING GASKET

"GRUV-SEAL" line of drop-forged iron ring gaskets for grooved joints are designed especially for high-pressure and high-temperature lines, where ready disassembly is required.



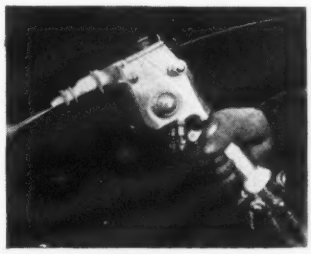
Drop-forged and pressed in a coin die to give perfect proportioning of rings. Units made of Armco ingot iron for pliability and corrosion resistance. Sizes from 2½ to 14¾ in. of Armco iron for high temperatures and pressures and of special acid-resisting metals for special service.

Steel Improvement & Forge Co., 960 Addison Road, Cleveland, Ohio.

ADJUSTABLE FUEL-OIL METERING PUMP

WICACO Type C-F adjustable fuel-oil pump can be used in handling "Bunker C" or No. 6 fuel oil. Has adjustable feature to eliminate necessity for regulating valves. Venturi tubes, viscosity controls, heretofore required in light commercial industrial burners, thus avoids clogging of attachments and resultant dangers. When solenoid or mechanically operated shut-off valves are used, pump is equipped with adjustable by-pass to prevent undue high pressure building up while burner is slowing down after valve has been shut off. Able to raise heavy oil at low temperatures from underground tanks, with tank temperatures down to 35 deg. Accurate construction, slow-speed operation (200 r.p.m.) through reduction gear unit, or similar speed drive. Adjustable to provide constant flow to burner, regardless of oil temperature, pressure or viscosity. Gears will pass any normal sediment found in No. 6 oil. Dual or two-stage units, with or without electric drive.

Wicaco Machine Corp., 4801 Stenton Ave., Philadelphia, Pa.



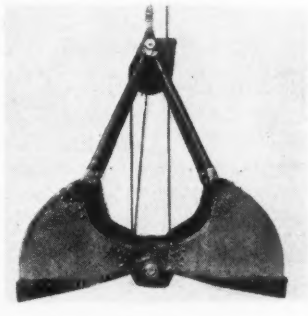
METAL ATOMIZER

COEN metal atomizer for metallic protective coating has special positive feed, permitting wire speed variations to cover all necessary ranges without changing gears. Will spray any metal obtainable in wire form on surfaces properly prepared with sand or grit blasting. Ball bearings throughout. Wire feed wheels tool steel, reversible. Gas, oxygen and air to tip controlled automatically with poppet valves operated by single lever. Special booklet.

Coen Co., 916 Bryant St., San Francisco, Calif.

REHANDLING GRAB BUCKET

TYPE RH bucket has special shells of intermediate shape between flat and round, giving advantages of flat shell for digging and filling, and round shell for quick discharge. Low height, extra width, and low center of gravity give less headroom in vessel or car and greater stability on a pile. Rope reeving without reverse bends and three-part purchase for rapid opening and closing. Top head is structural steel with manganese steel fairleader bolted in. Hinges cast steel of single and double ear construction with large bearing. All bearings with high-pressure lubrication. Links large diameter steel tubing welded to cast steel ends, to give greater strength with less weight.

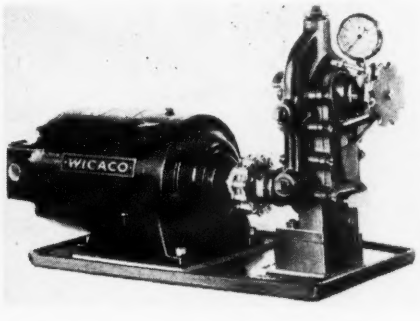


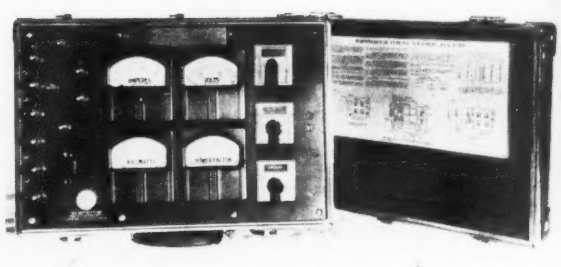
Mead-Morrison Division, Robins Conveying Belt Co., 15 Park Row, New York, N. Y.

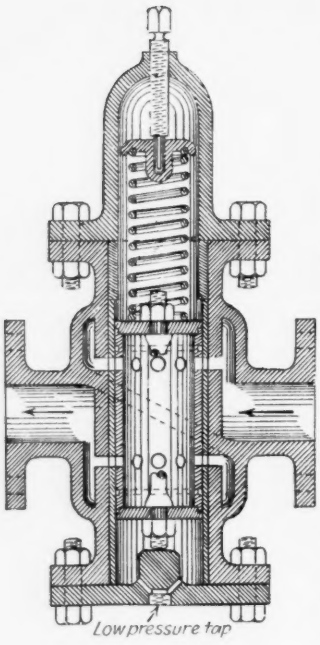
ELECTRICAL APPARATUS TESTER

"INDUSTRIAL ANALYZER" for testing electrical apparatus and motors has additional testing capacity instruments with knife edge pointers and fine line scale divisions, increased voltage range to 575 volts, manually operated pusher pointer for ammeter to obtain motor starting currents, new arrangement of panel and switching, providing disconnect features for potential circuits for use with transformers having grounded secondaries, or for use on two-phase, four-wire circuits and a new case. Does work ordinarily performed by ammeter, voltmeter, polyphase wattmeter, p.f. meter, four current transformers and voltage transformer. Size, 9¼x13¼x18⅝ in. Over-all accuracy of instrument within 1% for ammeter and voltmeter and 2% for wattmeter. Unit is miniature switchboard panel, complete carrying case with all switching equipment; including triple scale ammeter 0-5, 0-25 and 0-125 amp., triple range voltmeter 0-150, 0-300 and 0-600 volts, polyphase wattmeter with three scales for above voltage and current ranges, and polyphase p.f. meter with 10-100-80 scale to operate on the above voltages and currents. All instruments minature type with 3½-in. scales. May be used on circuits with voltages higher than 575 or currents greater than 125 amp., by use of extra current and voltage transformers.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.



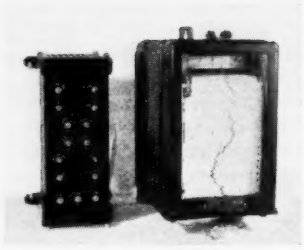




PRESSURE CONTROL VALVES

"ROUBELL BALANCED PISTON" pressure control valves for pressure, speed, flow, load and pilot control, with steam, water, air, gas, oil and chemicals. Three types, interchangeable pressure reducer and constant-pressure pump governor (illustrated), pilot valve control pressure reducer and excess pressure boiler-feed pump governor. Known as Series A, B and C, respectively. Unit illustrated is interchangeable, can be used either for straight pressure reduction or as constant-pressure pump governor. No diaphragms, dashpots or packing glands. One moving part. Position has no effect on operation. Piston wear absorbed by leakproof ring. Special alloy springs treated for high temperature. Guaranteed not to chatter or pulsate, and to have no pounding out. Valve is open when installed. Low pressure only controls action of valve, and valve operates regardless of initial pressure. Pilot valve control, Series B, is adaptable to very high pressures and will regulate in uniflow systems from high to any lower stage predetermined in one step or one valve installation. Recommended for close regulation in unvaried delivery pressures, regardless of fluctuations of initial pressure. Can be used for dead-end service. Series C type will shut off in case of broken line, preventing racing or overspeeding of overfeed pump. Both screwed and flanged types with semi-steel or steel bodies, in sizes from ½ to 8-in. Bulletin No. 103.

Crankshaft Machine Co., 320 N. Jackson St., Jackson, Mich.



GRAPHIC RECORDING KVA. METER

DESIGNED for use in making continuous record of electrical energy, this instrument embodies standard Model A.W. wattmeter with phase shifting network to supply wattmeter with lagging potential corresponding to average p.f. of circuit. By means of three sets of taps, unit is made to cover a range of p.f. from 0.54 to 0.94, with error not to exceed 1½%. Tap provided on phasing net work to permit measurement of reactive volt-amperes with same instrument. By omitting network, instrument can be used as graphic wattmeter. Furnished as complete unit or network can be furnished separately for use with existing meters. Supplied in combination 100-200-volt range, potential transformers being employed for higher voltages. Wide variety of ranges and ten different chart speeds. The charts uniformly divided and are 94 ft. long, Flushfront, wall and portable type.

Esterline-Angus Co., Indianapolis, Ind.

AUTOMATIC SUPERVISORY SYSTEM

THIS 5-point automatic supervisory system operates over two wires and provides for complete supervision of five substation units. Permits opening and closing of circuit breakers with indication of their position; starting and stopping of machines with indication of their condition; raising and lowering of speed, voltage or gates; obtaining of meter readings; and telephone conversations and calling. Supervisory equipment at dispatcher's office consists of control key, indicating lamps and supervisory devices for sending selection and control impulses, and for indicating positions of supervised units. Equipment at outlying station includes supervisory devices which transmit control impulses to auxiliary control relays and send back checking and indicating impulses to dispatcher's office. Substation equipment assembled in a case for panel mounting.

General Electric Co., Schenectady, N. Y.

INSULATING CEMENT

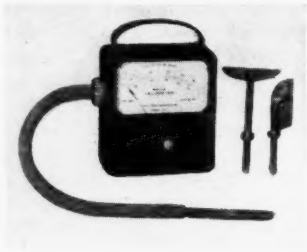
"SONITTEP" insulating cement is unaffected by temperatures up to 2,000 deg. F. Will stick to hot or cold surfaces, requires no reinforcement, is not loosened by vibration and shock. May be troweled to smooth finish and no finishing coat is required. Can be used for refrigeration or heat insulation. Prevents air infiltration and is soundproof. Claimed to have three times covering capacity and four times insulating value of asbestos cement, and to save 10 to 30% on fuel bills.

Geo. F. Pettinos, Inc., 1206 Locust St., Philadelphia, Pa.

DIRECT-READING AIR VELOCITY METER

BOYLE Velometer is a direct-reading air velocity meter which gives accurate and instantaneous readings of the speed and direction of air motion measured in feet per minute. Air enters through a port or jet and tube, depending on style, and leaves through a port on right side of meter. Air passing through actuates a movement comprising vane, control springs, pointer and magnetic damping system. No mathematical calculations or stopwatches required to determine velocity. Pointer locking button to lock pointer to retain reading or when instrument is not in use. Two types, each with double-range scale: shutter type with shutter for opening or closing port for changing range, and not provided for tube attachment. This is used for taking quick commercially accurate readings in heating and ventilating and air conditioning. Tube type illustrated is similar in size and appearance to shutter type. When used for low-range readings, tube attachment is removed and air enters directly through port. For high range readings tube attachment with suitable jet is used. Air enters through this jet. As tube is flexible, jet can be moved about as required, with instrument held stationary if desired. With the tube type unit accurate velocity readings of discharge or section of grilles, ducts or other restricted and small openings can be obtained. Special scales and attachments for unusual applications. such as high velocities, high temperatures and similar service. Standard scale range 0-300 and 0-3,000 f.p.m. High scale provides accurate readings up to the maximum limit of the scale. Over-all size, $5\frac{1}{4}$x$5\frac{3}{4}$x$2\frac{3}{4}$ in. Weight about 2 lb.

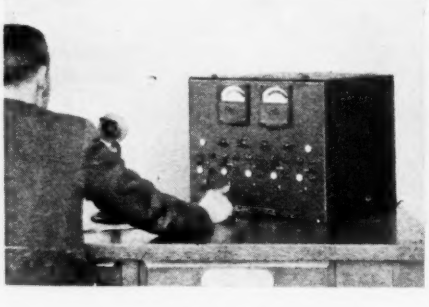
Illinois Testing Laboratories, Inc., 420 N. La Salle St., Chicago, Ill.

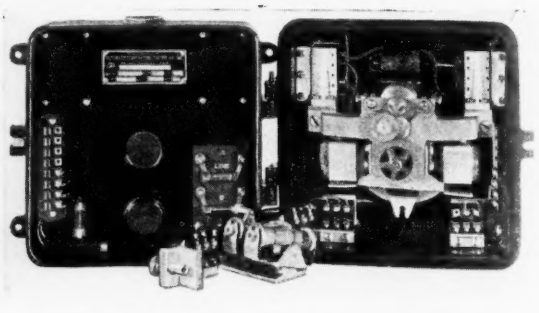


TIME CONTROL UNIT

SERIES 1274-5-6 time controls repeat one or two operations or processes as often as desired. Provision made for very flexible choice of periods during which controlled action takes place. Units will handle a repetitive action or operation requiring different time period or cycle with either same or different time period between successive time cycles. Time cycle and also interval between successive cycles is infinitely adjustable with accuracy within a split scale division of respective dial ranges selected. Parts grouped for simple adjustment. Jack connections permit removal of parts without disturbing wiring. Withstands vibration. Special contact metal. 110 volts, a.c., or 220 volts, a.c., if ordered. Catalog TC; Bulletin CRD.

Automatic Temperature Control Co., 34 E. Logan St., Philadelphia, Pa.





TURBINE FLOW METERS

FLUID meters will indicate and record water flow in terms of cubic feet per second and will continuously integrate in millions of cubic feet. Unit illustrated is one of a series for Boulder power plant to measure water supplied through a 13-ft. diameter penstock under an average net head of about 530 ft. Each meter will be designed for a maximum differential pressure of about 120 in. of water, and will be connected with Winter-Kennedy pressure connections in turbine scroll casing.

Bailey Meter Co., 1050 Ivanhoe Road, Cleveland, Ohio.

DIAPHRAGM VALVES

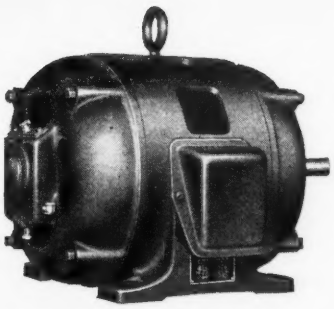
NEW type, long range throttling top incorporates arrangement for adjusting spring pressure so that member in contact with spring bottom does not turn when adjusting feed screw is turned, but merely moves up or down, guided by two vertical fins of spider arms. Thus, spring adjustment does not tend to wind up the spring or disturb its normal characteristic. Bulletin 1117.

C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N.Y.

METAL GATE VALVES FOR CORROSIVE SERVICE

"CAUSUL" austenitic ferrous alloy, particularly resistant to corrosion, is being used in gate valves in screwed and flanged patterns, also in indicator cocks with diamond-shaped port for acid sludge and oil burner service.

Lunkenheimer Co., Cincinnati.



POLYPHASE MOTORS

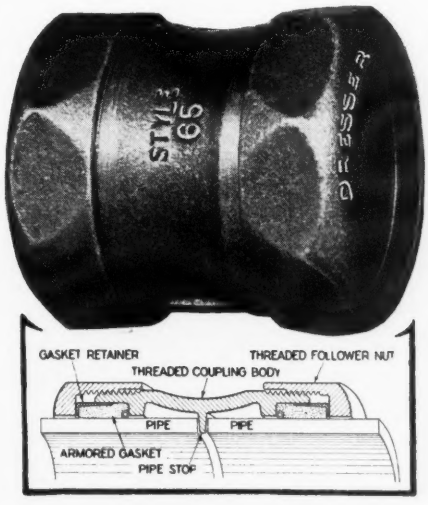
THESE squirrel-cage normal-torque and high-torque motors are especially designed for refrigeration and air conditioning on units including latest designs of Freon compressors. Cast frame and end brackets, well anchored field and rotor cores. Electrolytic copper bars and end rings joined to form homogeneous high-conducting joints. Available in sleeve or ball-bearing design in sizes 600 hp. and smaller.

Century Electric Co., 1806 Pine St., St. Louis, Mo.

PIPE COUPLING

STYLE 65 compression coupling uses plain-end pipe and makes a joint with an ordinary wrench. Pipe ends are inserted into coupling (which comes assembled) and then two threaded octagonal nuts are tightened on it. As nuts are tightened two resilient "armored" gaskets are compressed around pipe, grip it and give positive seal. Available black or galvanized in standard steel pipe sizes from $\frac{3}{8}$ to 2-in. I.D. Bulletin.

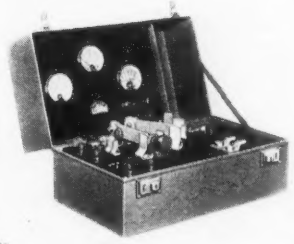
S. R. Dresser Mfg. Co., Bradford, Pa.

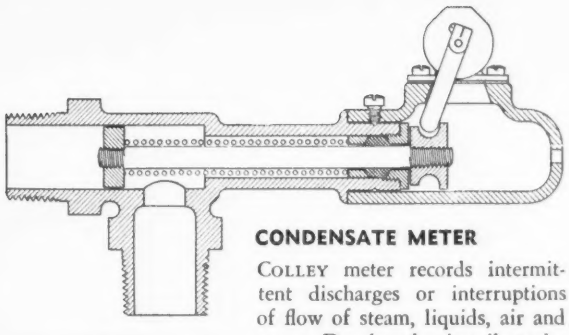


CIRCUIT TESTER

MODEL 3-DA portable volt-ampere meter combination requires no external shunts or multipliers and reads direct. Adapted to measuring currents and voltages on circuits from $\frac{1}{2}$ kw. to 100 hp., up to 250 amp. a.c. or 300 amp. d.c., and 600 volts either a.c. or d.c. Meters have multiple scales, for full scale deflection on almost any demand. Shunts, resistance, etc., are concealed and permanently connected. Includes three meters arranged for multiple reading in welded-steel case with small compartments for leads, tachometers, data, etc. Size, 9x9¼x16 in.

Leonard Electric Mfg. Co., 3907 Perkins Ave., Cleveland, Ohio.





CONDENSATE METER

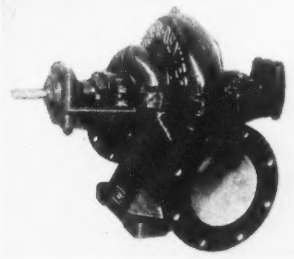
COLLEY meter records intermittent discharges or interruptions of flow of steam, liquids, air and gases. Developed primarily to indicate trap operation, may also be used with condensate meters to record number of trap discharges which, multiplied by amount of condensate per discharge, gives total condensate in steam line or steam consumption of individual units of equipment. As a trap indicator it will show if trap is operating properly, if it is blowing through or stopped up, or if the equipment to which it is attached is operating efficiently. Also may be used as warning device with electric attachment to give alarm when flow stops. Pressure changes in discharge line do not affect meter. Works with flow in one direction. Simple design incorporates loosely fitted spring-loaded piston inside cylinder acting against direction of flow. Piston rod packing held tight by spring and pressure in cylinder. Counter attached to piston rod records number of times piston has been pressed forward. When flow starts piston is forced forward to uncover exhaust port and operate counter. When flow stops, spring forces piston back to starting position.

Ammann - MacGregor, Inc., 2217 Olive St., St. Louis, Mo.

DOUBLE-SUCTION CENTRIFUGAL PUMP

THESE double-suction, single-stage, split-case units are recommended for general water supply and similar installations. Any type of drive including flat and V-belts, direct-connected gas or diesel engines, although usual drive has direct connection to electric motor. Series covers all heads to about 300 ft., each type covering certain percentage of head and thus enabling buyer to select exact type of pump for any head. All types identical in construction, differences being in dimensions. Claimed higher efficiency, easy operation and inexpensive maintenance. Shaft sleeve nut, outside pump and next to pumping housing. Nut is also used as jack to remove ball bearing, thus requiring no puller. Bulletin.

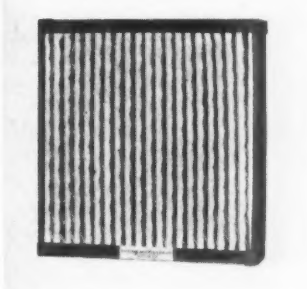
Gardner-Denver Co., Quincy, Ill.

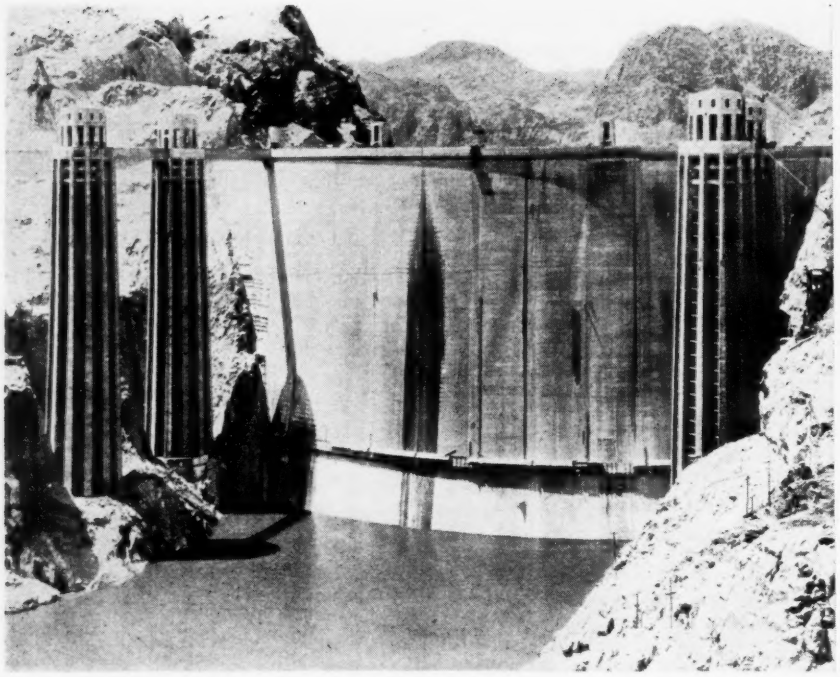


DRY TYPE AIR FILTER

"AIRPLEX" dry cartridge filter has lower resistance, high efficiency and gives long service. Filter medium is specially processed cotton, pleated back and forth 80 times to give over 30 sq.ft. of filter material in a frame 20 x 20 x 4 in. Medium will operate satisfactorily at temperature from minus 32 to plus 200 deg. F. Bulletin.

Davies Air Filter Corp., 390 Fourth Ave., New York, N. Y.





Acme

BOULDER DAM FINISHED

The upstream face; showing waters of the Colorado River swelling to form the lake that will eventually extend 110 miles upstream. As of July 11, water had reached el. 895 touching the bases of the four intake towers. On July 22 it was 84 miles long and 286 ft. deep at the dam. The powerhouse is still under construction

POWER LINES

Wind-Power Plant Near Berlin

Construction of the first large wind-power plant has begun with the 1000 kw. Teubert station near Berlin. All dimensions in this first construction have been chosen for about half the size of an economical large size plant, in order to study ensuing technical questions. The diameter from wingtip to wingtip is 60 meters. The axis is situated on a 60 meter high mast around which the shell containing the entire machinery rotates in a cranelike bearing, according to the direction of the wind, thus eliminating the need for a weathervane. Using a new switching and storage battery system the builders assure a steady kilowatt hour yearly output regardless of varying wind velocity and adjusted to the varying needs of consumers. The plant will not compete with present German power plants, but is intended for use in the country and small communities. A model of the station is being exhibited at the Leipzig Fair by the Wilhelm Teubert Windkraft-Zentrale, Berlin NW 87.

Engineers' Conference

Fifth Annual Economic Conference for Engineers is to be held at the Stevens Engineering Camp, Johnsonburg, N. J., August 10-18, 1935. Twenty-two sessions are scheduled for mornings and evenings on the general theme, "Taxation and the Cost of Government." List of speakers includes Dr. William B. Ennis, professor of economics of engineering at the Stevens Institute of Technology; Lawson Purdy, former president of the New York Department of Taxes and Assessments; Dr. Charles A. Beard, famous author; Hon. Harold G. Hoffman, Governor of New Jersey, and Mark Graves, New York State Commissioner of Taxation and Finance.

Diesel Trip

C. L. CUMMINGS, president of Cummings Engine Co., made a transcontinental trip in his rebuilt, diesel-powered, Auburn automobile, averaging 34.62 m.p.g. of fuel oil for 3,774 miles with top speeds of 75 miles an hour.

Testing Materials Society Meeting

Over 1,000 A.S.T.M. members and other technical men attended the 1935 annual meeting of the society in Detroit, June 24-28. Some technical papers and committee reports read, which may be of interest to *Power* readers, are "Relationship of Specifications to the Engineering Profession," by C. F. Hirshfeld, chief, Research Department, Detroit Edison Co.; "Corrosion Control in Air-Conditioning Equipment," by C. M. Sterne; "Continuous Flow Corrosion Tests of Steel Pipe," by Messrs. Rawdon and Waldron; Committee C-8's report on Refractories; Committee C-5's recommendations on the calorific value of fuel, and Committee D-19 report on water for industrial uses. Officers elected were: H. S. Vassar, laboratory engineer, Public Service Electric & Gas Co., president, and Prof. A. E. White, University of Michigan, junior vice-president. The 1936 annual meeting of the society will be held in Atlantic City from June 29 to July 3.

Air Conditioning On Tap at Radio City

A central cooling system, the first of this type ever installed in an office building, has been built into the Palazzo d'Italia and International Building in Rockefeller Center. A trio of 300-ton refrigerating machines has been installed in the sub-basements of the buildings to establish air cooling on the same basis as utilities like heat, electricity, gas and water. Every office in the new buildings has an outlet to pipes containing circulating water at about 42 deg. which a tenant can connect to his air-conditioning unit.

Unwin Memorial

Friends and past students of the late Dr. W. C. Unwin invite subscriptions to establish a fund to be utilized for commemorating the services of the man who was in his day a leading authority in many branches of engineering, including hydraulics, pneumatics, gas distribution, steam-power engineering, bridge construction, the design of masonry dams, strength and testing of materials and machine design. Donations should be sent to the honorary treasurer, E. G. Walker, 82 Victoria St., London, S.W. 1.

Increase in Industrial Activity

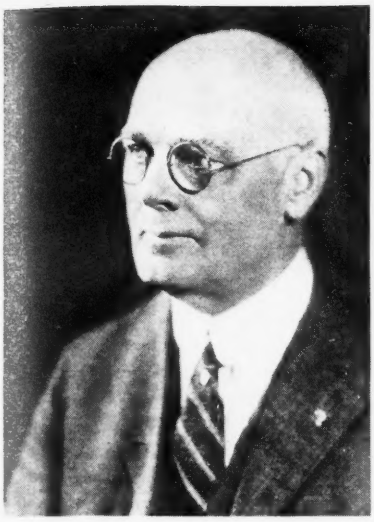
Industrial activity during the first six months of this year was markedly greater than during the corresponding period of 1934, according to a report issued July 21, by the National Industrial Conference Board. Among the indexes of production, automobiles were up 31.1 per cent, ingots down 1.6 per cent, house building up 58.0 per cent, petroleum up 5.8 per cent, bituminous coal up 3.7 per cent, machine tool orders up 46.5 per cent, electric power up 5.2 per cent.

A.S.M.E. Elections

WILLIAM F. RYAN, M. E., Stone & Webster Engineering Corporation, Boston, Mass., has been elected chairman of the local section of the A.S.M.E. for 1935-36. Prof. Walter E. Farnham, of Tufts College Engineering School, has been made vice-chairman, and Ernest L. Root, of the Permutit Co., Boston, secretary-treasurer. George C. Eaton, head of the mechanical technical division of the generating department, Boston Edison Co., has been made chairman of the program committee.

Industrial Conference

EIGHTEENTH Annual Conference on Industrial Relations will be held at Silver Bay on Lake George, N. Y., Aug. 28 to 31. Current industrial relation and government in industry problems will be discussed.



Fred R. Low Tours Passaic

Throughout his long illness Fred R. Low, Editor Emeritus of *Power*, has maintained his keen interest in the affairs of a world in which he formerly played such an active and varied part.

Early in July this resulted in a unique adventure. At his own urgent request, Mr. Low rode in an open ambulance through the streets of his home city, Passaic, N. J., to see for himself how things have changed since he was last about. Here is the story as told on the front page of the *Herald-News* (Passaic) July 2.

"For the last three years, Fred R. Low, former mayor of Passaic and famous engineer and author, has lain in bed, an invalid, but has followed Passaic happenings and improvements with intense interest through his daily newspaper and his hundreds of friends and relatives.

"Throughout the three years, Mr. Low often wondered how the City has changed and expressed a desire to see familiar streets again. Yesterday he had his wish gratified.

"Raised up in the bed of an ambulance, its sides taken down as in a summer trolley car so that he could see on all sides, Mr. Low was driven slowly through the streets of Passaic and neighboring territory until he had secured a picture of conditions vivid enough to satisfy his appetite.

"Accompanying the former Mayor was his daughter, Mrs. Arthur B. Whitney of Quincey, Mass., and his nurse.

"At his orders, Mr. Low went first to see extensive property he owns in Pennington Ave., and recent developments in the Third Ward Park, which he was instrumental in acquiring when Mayor in 1907.

"Mr. Low had developed a beautiful rock garden in his New Hampshire summer home before he was stricken. While in bed, he heard of one developed at the Ehrle Nurseries in Broad St., Clifton, and was driven there to see the layout and many flowers in bloom.

"He also had wondered where builders could have placed stores in front of the Erie Railroad depot in Lexington Ave., and had his chaffeur drive him there so that he could see the improvement. The trip also included all the principal streets of Passaic.

"The hour-long ride didn't weaken Mr. Low and he is in fine spirits today at his home, 256 Harrison St., where he and his wife reside."

World Power Conference

Committee on Foreign Affairs reported to the House of Representatives a bill extending an invitation to the World Power Conference to meet in the United States in 1936-1937.

COMING MEETINGS

American Welding Society—Fall meeting in conjunction with National Metals Exposition, Chicago, Ill., Sept. 30. W. Spraragen, secretary, 29 West 39th St., New York N. Y.

Ass'n of Iron & Steel Electrical Engineers — Annual convention and exposition, Wm. Penn Hotel, Pittsburgh, Pa., Sept. 24-26. Headquarters, 1010 Empire Bldg., Pittsburgh.

15th Exposition of Chemical Industries—Grand Central Palace, New York, N. Y., Dec. 2-7. Charles F. Roth, manager, Grand Central Palace, New York, N. Y.

National Ass'n of Power Engineers—Annual convention, Wm. Penn Hotel, Pittsburgh, Pa., Aug. 26-30.

7th Midwest Power Show—Chicago, Ill., Oct. 14-18. G. E. Pfisterer, managing director, 1 North LaSalle St., Chicago, Ill.

Maine Boilers

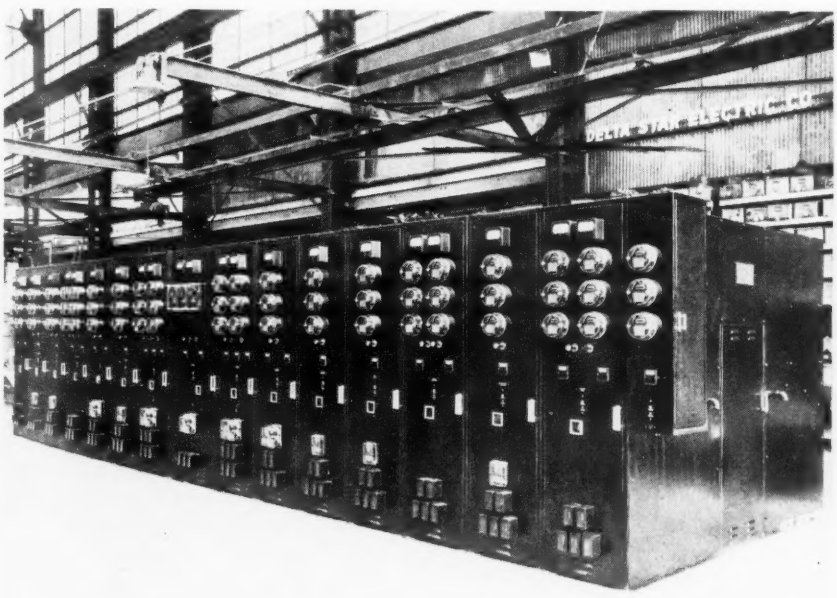
MAINE BOILERS must be inspected by a representative of the Department of Labor, according to a law passed in the Pine Tree State recently. Edward K. Sawyer has been appointed chief boiler inspector, and a board of appeals has been set up, headed by Charles O. Beals.

Welding Society Annual Meeting

JOHN J. CROWE, engineer in charge of apparatus, research and development, Air Reduction Sales Co., was elected president of the American Welding Society at its annual meeting, April 25. E. R. Fish, chief engineer of the boiler division, Hartford Steam Boiler Inspection & Insurance Co., has been elected senior vice-president. Turner C. Smith, General Petroleum Corp. of Calif., and E. E. Dillman, Wyatt Metal & Boiler Works, have been elected divisional vice-presidents. Directors include C. A. Adams, Harvard Engineering School; H. M. Hobart, General Electric Co.; F. T. Llewellyn, U. S. Steel Corp.; D. S. Jacobus, Babcock & Wilcox Co.; G. D. Spackman, Lukenweld, Inc.; H. L. R. Whitney, M. W. Kellogg Co., C. A. McCune, Magnaflux Corp., is treasurer, and M. M. Kelly continues as secretary and assistant treasurer.

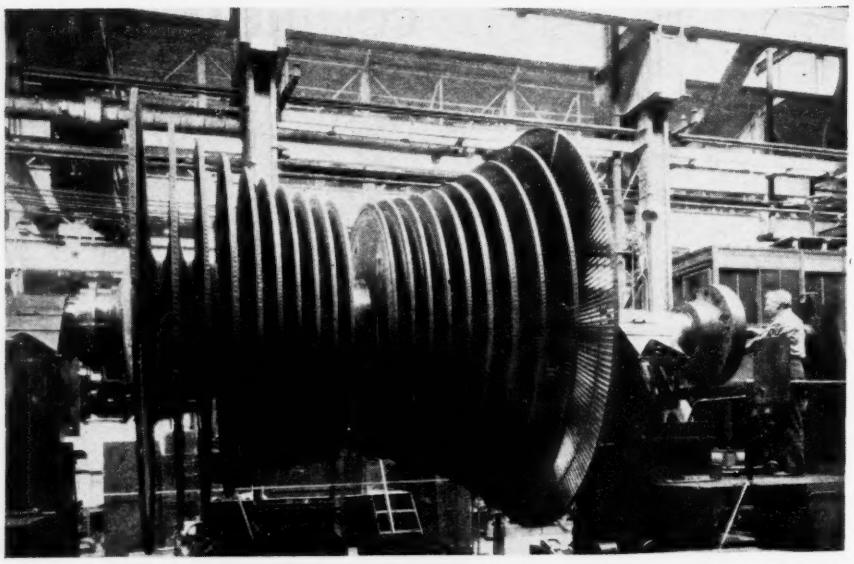
New England Engineers

HAROLD K. BARROWS was elected first vice-chairman of the Engineering Societies of New England for 1935-6. He is professor of hydraulic engineering, Massachusetts Institute of Technology, and a consulting hydraulic engineer. Other officers are: Leon F. Jackson, (treasurer), office manager, Linde Air Products Co., Boston; member of executive committee at large, Kenneth D. Hamilton, formerly plant engineer, Geo. E. Keith Co., Brockton, Mass., now representative of the Plant Engineers Club of Boston and industrial sales engineer, Norfolk Paint & Varnish Co., Quincy. George A. Montague, Mass. Dept. of Public Works is chairman, and Frederick W. Bliss, General Electric Co., Boston, is second vice-chairman.



BOULDER DAM SWITCHGEAR

Metal-clad Delta-Star auxiliary switchgear for Boulder Dam power house controls two 2,300 volts, 3,000-kva. station-service generators, one 3,000 kva. transformer bank and all 2,300 volt feeders for power house and dam auxiliary equipment. 30 units of this equipment are mounted in two parallel rows arranged back to back and include 30 oil-blast circuit breakers, insulated busbars, protective relays, meters and other appurtenances for complete switching and control units.



ROTOR FOR FORD

10-stage double-flow (20-wheel) rotor of the low-pressure half of the 110,000-kw. turbine-generator set being built by General Electric for Ford. The new generator, similar to the one placed in service in River Rouge station in 1930 but operating at higher temperature, will use steam at 1,200 lb. pressure and 900 deg. F. It will be a vertical-compound unit, with the 55,000-kw. high-pressure turbine and generator mounted directly on top of the low-pressure turbine and generator

PERSONALS

ALBERT D. WILSON, vice-president, has been elected president of Bristol Brass Corp., Bristol, Conn., succeeding the late Alex W. Harper.

WALTER E. BARNES has been appointed assistant to F. H. Gordon, vice-president in charge of sales, Lukens Steel Co., Coatesville, Pa. He has been with the company for 25 years.

THOMAS MARTIN, acting city electrician, has been permanently appointed head of the civil electrical department at Vancouver, B. C. He came to Vancouver in 1907, after service with the Bell Telephone Co., and joined the electrical contracting firm of Cope & Frey, Ltd.

WM. T. SHALER, formerly with S. Howes Co., Silver Creek, N. Y., has joined Ajax Flexible Coupling Co., Westfield, N. Y. as engineer. Clifford E. Broome, formerly with Wm. Ganschow Co., Chicago, Ill., and Gears & Forgings Inc., Cleveland, has joined Ajax as engineer in charge of the Lectrigear Division.

J. K. B. HARE has been appointed manager of the Buffalo office of Westinghouse Electric & Mfg. Co., taking the office formerly held by H. F. Boe, who has become assistant manager of the eastern district with headquarters in New York. R. J. Weber has been appointed central station sales manager of the Pittsburgh office.

THOMAS C. SWOPE has been appointed Texas and Louisianna representative, with headquarters at Beaumont, Texas, of Kennedy Valve Mfg. Co.

EDWIN SMILEY has been appointed sales manager of Cyrus Wm. Rice & Co., Inc., Pittsburgh, Pa. A. J. Forschner, former president of the Atlas Conveyor Co., is now at the Rice Philadelphia office.

G. N. HARRIS and J. G. Green, formerly of Westinghouse and Henry Harris, formerly president of United Electric Light Co., Wilmerding, Pa., have formed a corporation, Harris-Green Co., Farmers Banks Bldg., Pittsburgh, Pa., to sell motors, control, transformers, line material, power-factor corrective devices, and other similar materials.

W. S. LONG, formerly manager mechanical sales for the U. S. Rubber Products, Inc., Seattle district, has been transferred to the Los Angeles district, while C. W. Gilmer, formerly salesman in the San Francisco district, has taken over the vacated position. The New Orleans Branch has moved its office from 202 Fulton St. to 440 Canal St.

H. K. DUTCHER sailed from Vancouver, B. C., July 17, to accept an engagement for one year in charge of engineering work in association with Australian engineers on a water power and irrigation project for Australian Hydroelectric Commission.

EDWARD A. LOWENTHAL, former New York district sales manager, has been appointed industrial sales manager of Bird-Archer Co. R. E. Lester of New Jersey, will fill the vacated place.

ARCH MILLER has been appointed packing representative for the Pittsburgh district of the United States Rubber Products, Inc., Pittsburgh.

DR. IRVING LANGMUIR, associate director of the General Electric Research Laboratory at Schnectady and Nobel prize winner, has been elected to foreign membership in the Royal Society, England.

RUSSELL HASTINGS, public utility consultant, formerly connected with purchasing bureau of Boston Edison Co. and Fuel Administration at Washington, has been appointed rate engineer of the Edison Co.

HARRY W. BEEDLE has been appointed New England manager of Electric Storage Battery Co., Boston, Mass., succeeding Thomas H. Dooling, who was recently transferred to an executive position on the Pacific Coast.

JOSEPH B. ROBERTS will take charge of dealer operations of A. W. Chesterton Co., 64 India St., Boston, Mass.

E. H. FITZGERALD, U. S. Department of Labor Conciliation Service, Los Angeles office, has been sent by Secretary of Labor Perkins to Boulder Dam to act as mediator in the strike of 400 carpenters and steel workers there.

THEODORE H. ROSS has been appointed district sales manager (for Pittsburgh) of the Industrial Stoker Division of Combustion Engineering Co., Inc., New York.

JAMES J. ZIMMERMAN has been appointed works manager of the Osborne Machine Co., DuBois, Pa. He was formerly production manager for the Elliot Co., Jeanette, Pa.

JAMES T. SUTLIFF has moved from the factory of the Roots-Connersville Blower Corp. to its Chicago office at 20 North Wacker Drive.

JOHN G. BARRY, former senior vice president of the General Electric Co., retired and was immediately elected to an honorary vice-presidency. Formerly active head of the apparatus sales organization, he will maintain an office in Schenectady and will be available for consultation.

HERBERT I. SULLIVAN, superintendent of power, Eastern Massachusetts Street Railway, has been appointed superintendent of rolling stock and shops for that company with headquarters at 38 Chauncy St., Boston.

FREDERICK C. WILLIAMS, sales engineer, American Blower Corp., Philadelphia, Pa., has been transferred to the company's Boston office at 1003 Statler Building.

OBITUARIES

ELBERTON R. INGRAHAM, 64, former chief engineer of North Truro, Mass., Cold Storage, Inc., died on July 10.

JOHN D. WOOD, 58, former chief engineer of the Holyoke, Mass. Producers' Union, died July 11. He was a president of the steam operating engineers' union in Massachusetts.

WILLIAM H. POWELL, engineer in charge of d.c. design for Allis-Chalmers Mfg. Co., Milwaukee, Wis., died July 8. He was the inventor of the "Frog-Leg Winding," a fellow of the A.I.E.E. and was affiliated as electrical engineer with many prominent companies.

IRVING GILL MARSTON, 84, former president of I. G. Marston & Co., Boston, Mass., died on July 11.

COL. LEWIS W. CALL, formerly chief counsel of the Federal Power Commission, died in Washington, June 26. Prior and after his service with the Federal Power Commission he served in the office of the Judge Advocate General of the Army.

WILLIAM MULHOLLAND, 79, builder of the Owens River Aqueduct which supplies Los Angeles with water, died July 22.

BUSINESS NOTES

McCLAVE-BROOKS Co., Scranton, Pa., has moved its New York office from 1440 Broadway to 92 Liberty St. Wallace L. Higgins will continue in charge.

GENERAL ELECTRIC Co. Air Conditioning Department has moved from the G-E Building at 570 Lexington Ave., New York City, to the Bloomfield Works of the company at 5 Lawrence St., Bloomfield, N. J.

OWENS-ILLINOIS GLASS Co., Toledo, has moved its sales department of its Industrial Materials Division from Toledo to its Newark, Ohio, plant. Garland Lufkin, formerly manager of the Owens-Illinois factory at Bridgeton, N. J., is now in charge of the entire operation of the Industrial Materials Division. J. S. Irvine continues as sales manager.

NASON MFG. Co., 71 Fulton St., New York, N. Y., has merged its plumbing and steam supply business with Behrer & Co., Inc., under the name, Behrer-Nason Co., Inc., with offices at 77-81 Beekman St., New York, 45-50 Davis St., Long Island City, N. Y., and several district offices. The new company will include former officers and personnel of Behrer & Co., supplemented by members of the Nason staff.

U. S. SUPPLY Co., Omaha, Neb., has been appointed sales agent for American District Steam Co. for Nebraska, western Iowa, and northeastern Wyoming.

BROOKLYN ENGINEERING INSTITUTE, part of the Bedford Y.M.C.A., will start a diesel course Sept. 30, under direction of J. W. Anderson, whose treatise, "Diesel Engines," is now being published by McGraw-Hill Book Co. The purpose of the course is to train men as erectors, operators and service men.

LAWRENCE MACHINE & PUMP Co., Lawrence, Mass., has been purchased by Victor J. Mill, who will continue to operate it under the name of Lawrence Machine & Pump Corp. This company, formed in 1882, made the first American centrifugal pump.

AMERICAN ENGRG. Co., Philadelphia, Pa., has opened a district office at Baltimore, Md., in the Keyser Bldg., Calvert & Redwood Sts., in charge of Wm. M. Chatard.

BROWN INSTRUMENT Co., Philadelphia, and Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., have opened a joint office in Room 303, 101 Marietta St. Bldg., Atlanta, Ga. Wesley R. Moore is manager in charge with Leon L. Kuempel, Charles A. Kitzinger, and J. A. Crawley assisting him.

WOODWARD & McMILLAN, Aptdo. 1691, Edificio Metropolitana, Havana, have been appointed Cuban representatives of Link-Belt Co., Chicago, Ill.

REPUBLIC STEEL CORP. and subsidiaries, Berger Mfg. Co., and Union Drawn Steel Co., are moving their Philadelphia district sales office to Broad St. Station Bldg., 1617 Pennsylvania Blvd.

HARRISBURG PIPE BENDING Co., Harrisburg, Pa., has changed its corporate name to Harrisburg Steel Corp.

HENRY A. PETTER SUPPLY Co., Paducah, Ky., has been appointed distributor for the Link Belt Co., shovel and crane division, Chicago.

PITTSBURGH STEEL Co., has appointed Tubular Service Corp., 120 44th St., Brooklyn, N. Y., distributors in the New England and North Atlantic States.

OSBORNE MACHINE Co., DuBois, Pa., has opened a sales office at 829 Empire Building, Pittsburgh, Pa., under the direction of C. K. Wehn, former sales manager of Pennsylvania Fabrication Co.

ROBERT GAIR Co., and subsidiaries have moved their New England sales office to 77 Sumner St., Boston, Mass.

SCHOOL FOR WELDING OPERATORS has been opened in Hoboken, N. J., under the supervision of Mr. William Bozman, eastern service manager for Harnischfeger Corp., Milwaukee.

BUELL ENGINEERING Co., 70 Pine St., New York, has been established to manufacture drying systems and dust extraction systems.

STRAWS

Pointing the way business winds blow

LOS ANGELES, CALIF., Bureau of Power & Light has awarded a contract amounting to $700,000 to Westinghouse Electric & Mfg. Co., for a 60,000-kva. hydrogen-cooled frequency converter.

JOHN WANAMAKER'S, New York, plan to spend more than $500,000 to modernize the store. Plans provide for air conditioning and a change from direct to alternating current in both buildings. Electrical projects call for new motor equipment throughout, wiring for new power switchboard, and new lighting panel boards to 5,000 new circuits which will be installed. It also includes 12 large transformers, 16 electric elevator machines, 620 electric motors, 450 electric fans, new fire alarm system, and new refrigeration system.

PICKWICK LANDING DAM, Savannah, Tenn., electrical generating equipment will be made only as the demands for TVA power justify such installation. When the dam is completed the power-house will be left in an incompleted condition, pending installation.

ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT, sponsored by leading national engineering societies, has inaugurated a program for accrediting engineering schools in New England and the Middle Atlantic states. The program will be offered to other parts of the country after a trial period in these two regions.

ROCKVILLE CENTRE, N. Y., voters ratified a proposition to enlarge the municipal electric power system at a cost of $260,000. The federal government will give the village 30 per cent of the sum needed, while bonds will be sold to banks to finance the remainder.

PASSAMAQUODDY funds for a year's work have been allotted, and Maj. Philip P. Flemming has established headquarters at Eastport, Me. Work will start at once on an office building and housing for the staff.

RURAL ELECTRIFICATION ADMINISTRATION expects to propose to the advisory committee on allotments a substantial number of loans to finance construction of new power and light projects in rural districts not now having electric service. Under suitable conditions, REA will lend the entire cost of building power and light lines in areas now without electric service. Loans will be for 20 years normally, at the low interest rate of 3 per cent.

COLUMBIA POWER Co. will install a diesel plant to supply Terrace, B. C., with electric light and power service. Except for small private plants, there have been no electric lights in Terrace since the old privately owned plant was burned out one year ago.

MID-WEST PIPE LINE Co., GRAND RAPIDS, MICH., is planning construction of a welded steel pipe line from natural gas fields in Gratiot and Montcalm, Mich., districts to Alma for gas supply for the Consumers Power Co., Jackson, Mich., which will distribute at Alma, St. Louis and Breckenridge, installing pipe lines for this purpose; Mid-West company will also build a welded steel pipe line for crude oil transmission from Crystal oil fields, Montcalm, to Alma, for service for refining plant of the Mid-West Refining Co. Entire projects will cost in excess of $200,000.

LOUP RIVER PUBLIC POWER DISTRICT, COLUMBUS, NEB., will soon begin construction of hydroelectric generating plant in vicinity of Columbus, in connection with power and irrigation project now under way. $613,177 contract for power station and irrigation construction has been awarded to George W. Condon Co., and Peter Kiewit Sons Co., both of Omaha, Neb. Entire project will cost $7,300,000. Financing has been arranged through Federal aid. Harza Engineering Co., 20 North Wacker Drive,, Chicago, Ill., is consulting engineer. Fred Albert is engineer at Columbus.

CHANDLER HEIGHTS CITRUS IRRIGATION DISTRICT, CHANDLER, ARIZ., has concluded arrangements for financing through Federal aid of $47,250 for development of irrigation facilities, including construction of a new electric-operated pumping plant for booster service, extensions in electrical distributing lines, pipe lines and other work.

South Carolina Public Service Authority, Charleston, S. C., has plans maturing for a hydroelectric power and navigation project on the Santee and Cooper Rivers in the eastern part of the State. The project will include the construction of a large power dam, hydroelectric generating station, transmission and distributing lines, and other power facilities, in addition to river navigation construction. A fund of $37,500,000 has been approved by the PWA for the program, of which 45 per cent will be a grant and the remainder, $20,625,000, a loan over a period of 30 years. It is proposed to begin work on the project early in the fall, with completion estimated about 24 months later. Murray & Flood, 369 Lexington Avenue, New York, N. Y., are consulting engineers.

Columbia Gas & Electric Corp., New York, N. Y., operating Panhandle Eastern Pipe Line Co., Kansas City, Mo., is negotiating with city officials at Detroit for natural gas supply for commercial and industrial service in that municipality; it is proposed to construct a welded steel pipe line from present terminus of Panhandle Co. line from the Texas gas fields at Dana, Ind., to Detroit, a distance of about 300 miles, with estimated cost placed at $8,500,000, including distribution facilities at Detroit.

Consumers Power Co., Jackson, Mich., has begun construction of a welded steel pipe line from Millbrook gas fields, on Montcalm County line to a connection with its main pipe line in Broomfield Township, about 30 miles, estimated to cost $180,000. Cooperating in the project, Petroleum Transportation Co., Alma, Mich., will build a series of steel pipe lines for gathering service in the Millbrook pool area, to serve the main lines of the Consumers Power Co., estimated to cost about $50,000.

Crystal Natural Gas Co., Crystal, Mich., is planning construction of a welded steel pipe line from gas fields in Montcalm County to the Crystal Lake district, for natural gas supply; company is securing a 25-year franchise for furnishing gas for heating and industrial service; project will include a pipe line distribution system and is reported to cost over $100,000.

Dresden Paper Mills Co., Dresden, Ohio, is completing plans for a new boiler house at paper mill, with installation of boiler units and accessories. Cost estimated over $25,000. Work will begin soon. A. M. Kinney, Inc., Carew Tower, Cincinnati, Ohio, is consulting engineer.

State Dept. of Administration and Finance, St. Paul, Minn., has authorized plans for extensions and improvements in power plant at State Asylum, Willmar, Minn., to include one-story addition and installation of new equipment. Cost close to $50,000. G. M. Orr & Co., Minneapolis, Minn., are consulting engineers. Bids are scheduled to be asked in August for a similar improvement at power house at State institution at Faribault, Minn. Cost about $30,000. Pillsbury Engineering Co., Minneapolis, is consulting engineer.

Bureau of Reclamation, Denver, Colo., plans large pumping plant for irrigation feature of Grand Coulee power project, Grand Coulee, Wash., to be located a short distance upstream from west abutment of power dam. Station will have a rated capacity of 16,000 sec.-ft., consisting of 20 single stage pumping units, operated by a 33,000-hp. motor, each pump with a capacity of 800 sec.-ft., when operating under a total head of 370 ft.; a pipe line, 1½ miles long, will be constructed. Complete irrigation section of the program is estimated to cost about $208,000,000.

American Distilling Co., New York, N. Y., plans one-story power house in connection with proposed brandy distillery near Staunton, Va. Distilling plant will consist of several units and cost approximately $350,000.

Westminster, S. C., plans new municipal hydroelectric generating plant on Chauga River. Work will include power dam, generating station, transmission and distributing lines, and power substation facilities. Project will cost about $114,000. Financing is being arranged through Federal aid.

Galax, Va., has preliminary plans under way for municipal electric light and power plant, and electrical distribution system. Entire project is estimated to cost $582,000. Financing through Federal aid.

Sparks, Nev., is projecting plans for municipal electric light and power plant, and electrical distributing system. Estimates of cost are being made. Extensions and improvements in waterworks station and facilities will also be carried out. R. H. Hill is city engineer.

Platte Valley Power & Irrigation District, North Platte, Neb., developing a hydroelectric power and irrigation project in the vicinity of Sutherland, Neb., and the Loup River Public Power District, Columbus, Neb., have secured an additional appropriation of $3,600,000 through PWA for connecting the two power systems. Changes will be made in power station installations for inter-connection and a high-tension transmission line will be constructed between the two individual systems. Federal allotment of $1,000,000 has been secured for construction of a loop power distribution system at Omaha, Lincoln, Sioux City, Columbus, and neighboring municipalities. Parsons, Klapp, Brinkerhoff & Douglas, New York, and Harza Engineering Co., Chicago, Ill., are consulting engineers.

Abbeville, S. C., has plans under way for a municipal hydroelectric power development on the Rocky River, Abbeville County. Project will comprise a concrete power dam, generating plant and transmission line to city, where substation will be located. Financing of $350,000 is being arranged through Federal aid.

Seminole Dam and Power Plant, Casper-Alcova Project, Wyoming, will be placed under way by the Bureau of Reclamation, Casper, Wyo., at early date. Bids have been asked on general construction with materials and equipment to be purchased and furnished by the Government. Bids will be asked in the future for generating equipment and other electrical apparatus, as well as for transmission lines and distribution equipment.

Corning Fights The Flood

Continued from page 422

then even greater than the condenser requirements, so we had to use the plant fire pump to get at the strainers. Finally the river came over the top of the concrete sump, swamping the strainers, which soon clogged and shut down the next largest generating unit.

We now had only a 500-kw. non-condensing unit, which we kept above water by brick, sand bags and pumps. Had we operated our boilers on coal it would have been very difficult to keep up steam because our draft fans were under water.

It may interest other engineers to know how we dried out the water soaked motors. The smaller motors we piled up against the hot sides of our furnace walls. A fan carried away the evaporation. Our large synchronous motors were dried in place. We used our electric welder, applying low voltage and high amperage by connecting the D.C. side of the welder to the stator leads of the motors, taking one phase at a time. At the same time we gave full field current from the plant D.C. supply. During this operation we ventilated the windings with a unit heater by blowing hot air into them.

This operation took from 24 to 36 hours, after which time the machine was put on the line.

While the flood was at its highest every member of our organization displayed a wonderful spirit of cooperation. Executives, laborers, engineers, Ph.D's and others had their boots on and were willing to help and take instructions from anybody who was able to make a reasonable suggestion. Water was coming in from everywhere. Equipment, furniture, files and records on the lower floors had to be saved. Many worked their heads off; others were running around trying to find a place where they could make themselves useful. It was a wonder no one was electrocuted, as many times the water was charged with current ranging from 110 to 2300 volts.

A crew of spectators were watching the river. They also helped. Minute by minute they reported the level of the river. "It is coming up." "It is coming up 2 inches in 15 minutes." At 10 p.m. Monday the river was holding its own, and shortly after started slowly to go down. The telescope disc had been saved. The gas pressure was still normal. The power was on and no one had been hurt.

LONGMONT, COLO., plans early installation of new Diesel engine-generating unit, about 1400 hp. capacity, with auxiliary equipment for standby service at municipal electric light and power plant.

CHISHOLM, MINN., is planning a municipal steam power plant for central heating service. Estimates of cost are being made and financing will be carried out through Federal aid. R. D. Thomas, Minneapolis, Minn., is consulting engineer.

CURRENT RIVER POWER CO., KANSAS CITY, MO., has made application to Federal Power Commission, for a preliminary permit for construction of a hydroelectric plant on the Current River in Ripley and Carter Counties, Mo. Project will comprise a large power dam, hydroelectric generating station and transmission system in a group of counties in the immediate vicinity. It is reported to cost over $2,000,000.

BELLEVUE, OHIO, is considering a new municipal electric light and power plant, with electrical distribution lines. R. Husselman, Cleveland, Ohio, consulting engineer, has been engaged to make surveys and estimates of cost. Work will be under way early in the fall. Preliminary estimates indicate that project will approximate $200,000.

BUREAU OF RECLAMATION, DENVER, COLO., has secured approval of a fund of $15,000,000 for construction of a hydroelectric power and irrigation project on the Lower Colorado River, near Bluffton, Tex. The development will be carried out by the Lower Colorado River Authority, a Texas State commission, under the direction of the Bureau. Contract for the allotment satisfactory to the PWA is now being consummated and it is expected to begin actual work on the program at early date.

SHAWNEE, OKLA., has plans under way for installation of Diesel engine generator set and auxiliary equipment at municipal electric light and power plant. Bids are to be asked soon. New unit is estimated to cost about $60,000. W. R. Holway, Tulsa, Okla., is consulting engineer.

SPRING VALLEY, MINN., will ask bids about the middle of August for a new municipal electric light and power plant, and electrical distribution system. Installation will include Diesel engine-generating equipment, fuel oil storage tanks, cooling tower, switchboard and instruments, and complete accessory apparatus. Fund of $110,000 has been arranged for project. G. M. Orr & Co., Minneapolis, Minn., are consulting engineers.

UNITED STATES ENGINEER OFFICE, ROCK ISLAND, ILL., has awarded contract to the Kelso-Burnett Electric Co., 223 West Jackson Boulevard, Chicago, Ill., for installation of power and control system, including electric lighting facilities, at Lock and Dam No. 16, Mississippi River, near Muscatine, Iowa, at $93,745.

OKLAHOMA NATURAL GAS CO., OKLAHOMA CITY, OKLA., is planning additions in welded steel pipe lines for natural gas distribution. A new line will be built from Edmond, Okla., to Oklahoma City, a new 12-in. welded steel line will be constructed in the southern part of the city for trunk line service; 4 and 6-in. welded steel pipe lines will be built at West Point, Okla., and improvements and replacements will be made in line from gas fields at Chickasha, Okla. Program will cost close to $300,000 and will be under way in August.

LAKE PLACID, N. Y., plans extensions and improvements in municipal electric light and power plant, with installation of equipment for replacements. Program is reported to cost about $35,000. C. W. Judson, Lake Placid, is engineer.

UNITED STATES ENGINEER OFFICE, SACRAMENTO, CALIF., has received low bid from the Frederick W. Snook Co., San Francisco, Calif., for construction of three large electric-operated pumping plants in the Sutter By-Pass, a portion of the flood control project on the Sacramento River, at price of $212,-175, and is scheduled to receive award at early date.

DANVILLE, VA., has secured final approval of Federal loan and grant of $2,750,000 for municipal hydroelectric power plant on the Dan River, near Pinnacles, Va. Two power dams will be constructed with hydroelectric generating station and other auxiliary structures. Transmission line will be built from site to city limits at Danville.

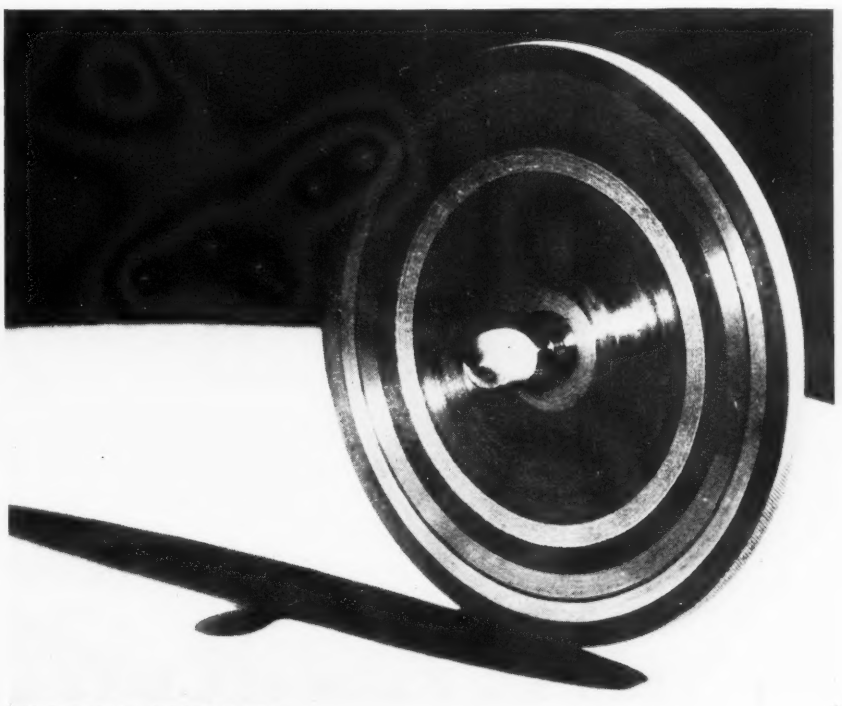
OKLAHOMA STATE PLANNING BOARD proposes a large hydroelectric power development on the Grand River, near Vinita, Okla., consisting of power dam, generating station, substations, switching stations, transmission lines and distributing facilities. Complete project will cost about $15,000,000 and application is being arranged to PWA for grant and loan. Victor H. Cochrane, Tulsa, Okla., is consulting engineer.

OWENSBORO, KY., plans extensions and improvements in municipal electric light and power plant, including installation of a new turbo-generator unit and auxiliary equipment. Entire project will cost close to $130,000.

IDAHO FALLS, IDAHO, has authorized extensions and improvements in upper municipal electric light and power plant, to include installation of new equipment. Program is estimated to cost about $45,000 and financing will be carried out through Federal aid.

COLUMBUS, OHIO, is considering extensions and improvements in steam department of municipal electric light and power plant, including installation of new high-pressure boiler unit and auxiliary equipment. Improvements will be made in water supply lines. Program is estimated to cost about $160,000. R. N. Tucker is superintendent at station.

COLUMBIA, MO., has work under way on extensions and betterments in municipal electric light and power plant, to include installation of a new turbogenerator unit and accessories, condensers and complete auxiliary equipment. Capacity of station will be increased. Project will cost close to $225,000. Burns & McDonnell Engineering Co., Kansas City, Mo., is consulting engineer.



A SPRAYED-METAL GADGET

Something unusual in sprayed molten metal, this paper weight is a ¼-in. section of a 4¾-in. dia. bar built up of ten metals on a ⅝-in. cold-rolled steel core 14 in. long. James W. Gibbons, asst. plant engineer of the Brooklyn refinery, American Sugar Refining Co., made it to show what can be done. Separated by sprayed copper bands, the eleven metals are (from outside in): Monel metal, cadmium, tin, copper, aluminum, lead, low-carbon steel, manganese bronze, stainless steel, zinc, cold-rolled steel. It also presented an unusual sawing and machining problem

OVERPREDICTION

What has always been our trouble is overprediction, not overproduction. Calamity howlers constantly predict that we're on our way to the dogs, chronic Pollyannas predict prosperity around the corner. There have always been and always will be these predicters. You can tell 'em when they're knee-high to a duck—either warning the rest of the kids about the Bogey Man or trying to egg somebody else on into a scrap so they can sit by and watch. Maybe it's just another example of some of the people that never grow up.

We may as well realize that we'll always have politicians who promise everything before election, then proceed to forget it afterwards. Likewise we'll have these Big Business Men who view-with-alarm everything a government does for or against them, and those reformers who prate of remaking the world overnight.

But for Pete's sake, let's the rest of us forget about it. We are born, we live, we have children, we die—just as our grand-dads did and our grandsons will.

But we have one big advantage over lots of other people. You see, anything we do, every place we go, the things we eat, the things we wear, the places we live in, all depend on power. And we're the boys who supply it. Until somebody succeeds in putting a petcock on the energy in the atom—if somebody ever does—they're going to need power of the kind we know how to make.

To make that power, we'll need the best equipment available. We must continue to take advantage of every development to make our task easier or to make the power we produce more cheaply. That's a part of our job, at least as important a part as producing the power in the first place.

To find out about that new equipment—and the new methods and systems that help to cut the cost of power services—hot and cold water, compressed air, and so on—we must keep both eyes and ears open. That sounds like a sermon, but it's just a statement of fact. In producing power, after all, we have hold of a tiger's tail—it's a hard job to keep on running but it's a hell of a lot better to hang on than to let go.

The tiger in this case is competition—from other power producers, other engineers, from anyone or anything that can come in and show how those who use your power or steam can get it more cheaply than you have gotten it for them. To keep up with the tiger you've *got* to hang onto his tail.

To hang on, there are any number of helps. One is contact with other engineers, another is meetings of technical groups, another is written material like articles and reports.

And another very important one is the advertising of individual manufacturers. Nothing adds more to the "tiger's" vigor than advances in equipment design. Nobody knows more about these than the fellow that makes them. Watch the advertising every month. You'll find the leaders there regularly, spending real money to keep us up to the minute on equipment progress.

Our job isn't economic prediction. It's economical production.

George Edwards

GEORGE EDWARDS
Engineer

For Fractional H.P. Motors A marvel of advanced engineering and compact design! The new C-H Bulletin 9101 is a complete unit of Motor Control, bringing to the fractional horsepower motors of home, office or factory, new simplicity of control and positive protection against overloads.

NEW 9101

Small enough to fit in your hip pocket
Sturdy enough to serve in a steel mill

Cutler-Hammer engineers have scored again . . . this time to save time, trouble and expense for both the makers and users of fractional horsepower motorized machines. Check these outstanding features of C-H Bulletin 9101 Motor Control:

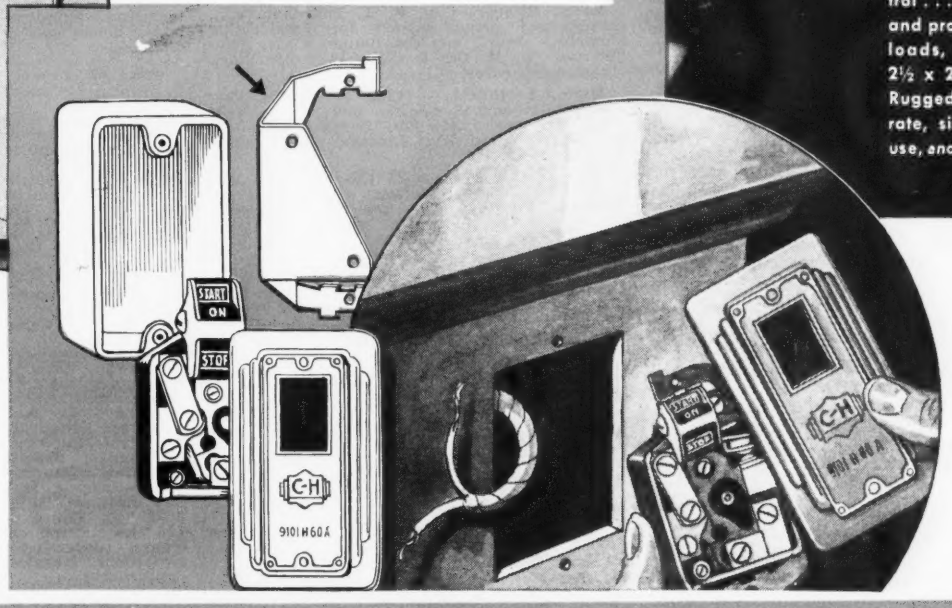
(1) A complete unit of Motor Control, yet only 2½" x 2½" x 4¼" overall. (2) Extra large shroud-protected push buttons easily operated even by gloved fingers. (3) Indicates "ON" and "OFF" under either manual or automatic overload operation. (4) Free-tripping overload protection. (5) Reset after overload made automatically. (6) Double solid silver to solid silver contacts—non-rusting parts and insulation unaffected by moisture. (7) C-H eutectic relay with overload protection in 10% increments makes fullest use of motor, stops it only where actually endangered by overload. (8) Top, surface or cavity mounting. Ideal for "inbuilt" control on any machine.

Ask for C-H Bul. 9101. Carried in stock by reliable independent electrical wholesalers everywhere. CUTLER-HAMMER, Inc., *Pioneer Manufacturers of Electric Control Apparatus,* 1358 St. Paul Ave., Milwaukee, Wis.

A complete unit of Motor Control . . . starts and stops motors and protects them against overloads, yet it measures only 2½ x 2½ x 4¼ inches overall. Ruggedly built, extremely accurate, simple to install, easy to use, *and* decidedly good looking.

OVERLOAD PROTECTION

C-H Overload Relay in 9101 passes all harmless overloads, does not stop motor unless actually endangered. Also push buttons return to "OFF" when motor is stopped by overload so user is not confused. To restart after overload, only "START" need be pressed—no relay reset is needed. Further, relay action is free-tripping so user cannot force motor to run under harmful overload by holding "START" depressed. These features save time, trouble, tempers and service calls.



Adapter plate (indicated by arrow) provides for variety of easy mounting means as "inbuilt" control in machines. Switch is enclosed in bakelite body even with cover, adapter plate and steel shell removed.

TO MACHINE BUILDERS

Ingeniously arranged for top, surface or cavity mounting. Ideal for "inbuilt" control on any machine. Internal terminal board simplifies wiring. Write for sample on company letterhead.

CUTLER-HAMMER C-H MOTOR CONTROL

NEW BULLETINS

Valves — Parker Appliance Co., 10320 Berea Road, Cleveland, Ohio. 60-page booklet No. 38 covers typical variety of valves, gives specifications and price lists, lists on more common standard types. Also 32 new dimension sheets of engineering data and two new bulletins on tube fabrication and tubing.

Motors—Louis Allis Co., Milwaukee, Wis. This company publishes every other month a 24-page magazine, "The Louis Allis Messenger," for those interested in purchase or maintenance of electric motors. Printed in color and includes engineering data and technical articles, as well as general subjects.

Gas Separator—Hill Mfg. Co., 370 Lexington Ave., New York, N. Y. 4-page bulletin "Reduce Your Operating Costs With a Hill Improved Float-Type Non-Condensable Gas Separator." Used in refrigerating plants. Includes ammonia condenser pressure table.

Pyrometers—C. J. Tagliabue Mfg. Co., Brooklyn, N. Y. 8-page folder, "A Beam of Light, A Mirror-Galvanometer, A photo-electric Cell," describes this company's pyrometers and gives examples of performance.

Refractory Insulating Brick — Chas. Taylor Sons Co., P. O. Box 58, Annex Station, Cincinnati, Ohio. Booklet giving engineering data, comparative tests and performance reports on this company's refractory insulating brick recommended for use at temperatures to 2,500 deg. F., uncoated, and to 2,600 deg. F. when coated with P. B. Sillimanite air-setting cement.

Radiant-Heat Boilers—Union Iron Works, Erie, Pa. 6-page Bulletin on Union radiant-heat boilers for boiler plants; shows several typical installations and gives operating data.

Diesel Tractors—Caterpillar Tractor Co., Peoria, Ill. 44-page catalog on diesel "Forty" tractors, printed in two colors, showing model and action pictures, illustrates text, gives data on tractors and corresponding power units.

Industrial Power Transmission — Power Transmission Council, 370 Lexington Ave., New York, N. Y. Sponsored by Mechanical Power Engineering Associates, this 36-page bulletin, "A Practical Analysis of Some Fundamentals of Industrial Power Transmission," gives data on modern group drives.

Low-Voltage Cable—General Electric Co., Schenectady, N. Y. 4-page GEA-1885 on Low-Voltage Secondary Cable for Networks and Other Secondary Distribution Circuits. Also GEA-1662A, 4 pages, on Trip-Free Air Circuit Breakers.

Boiler—Combustion Engineering Co., Inc., 200 Madison Ave., N. Y. Folder describing VM boiler for small and medium-size plants. Blue-print reproductions show typical settings with underfeed chain and traveling-grade stokers as well as with pulverized coal.

Air Filters—Coppus Engineering Corp., Worcester, Mass. Two bulletins: F-320-3 describes a filter for motor and generator intakes and for general industrial use; F-310-2 contains data on filters for air compressors, internal-combustion engines, etc.

Brush Maintenance—Ohio Carbon Co., 12508 Berea Road, Lakewood, Ohio. Booklet dealing with the causes and cure of sparking, excessive wear, etc., of brushes, commutators and slip rings of d.c. and a.c. motors and generators.

Condensers—Aerovox Corp., 70 Washington St., Brooklyn, N. Y. General engineering data on electrolytic and oil-filled industrial condensers, as well as their application to motor-starting, power-factor correction, etc., in a 28-page manual and catalog.

Condenser Tubes — Scovill Mfg. Co., Waterbury, Conn. 12-page booklet on installation methods and ferrule specifications for condenser tubes. Also describes the four Scovill alloys and lists prices for installation tools.

Instruments — Brown Instrument Co., Wayne & Roberts Ave., Phila., Pa. Folder describing instruments for measuring flows, temperatures, drafts, etc.

Lubrication—Ideal Lubricator Co., Packard Bldg., Phila., Pa. Illustrated, 30-page booklet describing a system for lubricating all types of bearing surfaces.

NEW PLANT CONSTRUCTION

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Calif., Alameda—City seeking P.W.A. funds to finance construction electric light plant. $125,000 or more.

Calif., Camarillo — State plans by G. M. McDougall, state archt., P. Wks. Bldg., Sacramento, dormitory for custodial group of males, $1,050,000; industrial building, $75,000; dining room, $85,000; boiler and mechanical work, ground lighting, etc., $55,000; flood control, $20,000; laundry, $75,000; attendant's quarters, $140,000; dairy and poultry buildings, $100,000; commissary and refrigeration, $120,000; morgue $10,000; garages, $10,000; unbudgeted reserve, $150,000, all above at State Hospital grounds. Total est. $1,890,000.

Calif., Stockton—State plans by G. M. McDougall, state architect, P. Wks. Bldg., Sacramento, hospital units, incl. dormitories $800,000; addition to kitchen and dining room $100,000; attendant's quarters $94,500; boiler house $15,000; boiler, piping $15,000; sewage plant addition $25,000. Total est. $1,049,500.

Ga., Brunswick — Municipality surveys in progress electric power plant. To exceed $100,000. J. F. Ahern, Jacksonville, Fla., engr.

Ill., Wood River — City plans constructing power plant. $350,000. Report will be completed soon. Burns & McDonnell Eng. Co., 107 Linwood Blvd., Kansas City, Mo., engrs.

Ia., Iowa City—City soon takes bids power plant equipment. $400,000. Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, Mo., engrs.

Ia., Villisca — City revising plans complete power plant and distribution system. $140,000. Burns & McDonnell Eng. Co., 107 Linwood Blvd., Kansas City, Mo., engrs. Noted June 28, 1934, C. D.

Kan., Burlington—City, project for light plant delayed owing to public utility company filing application with supreme court for rehearing. $45,000. E. T. Archer & Co., 609 New England Bldg., Kansas City, Mo., engrs.

Kan., Cherryvale—City plans power plant. E. T. Archer & Co., 609 New England Bldg., Kansas City, Mo., engrs.

Me., Eastport—U. S. Eng., Eastport, bids after Aug. 1, constructing central heating plant in connection with Passamaquoddy Bay Dam and Power Plant, at Eastport and Lubec, Fels Co., 42 Union St., Portland, engrs., J. C. Calvin & J. H. Stevens, 187 Middle St., Portland, and J. P. Thomas, 537 Congress St., Portland, have been selected to prepare plans constructing 250 houses for employees for same project, incl. 2 story, frame office building, frame hospital, 2 story, frame guest house residence, two 2 story apartment houses.

Mich., Battle Creek — Michigan Carton Co., plans by Shreve, Anderson & Walker, Brook Bldg., Detroit, power plant, plant addition, etc. $100,000 or more.

Mich., Kingsford—Municipality plans electric light and power plant. To exceed $40,000. Federal Eng. Co., Davenport, Ia., engrs.

Minn., Glencoe—City, F. X. Eickmann, clk., surveys and plans ordered for constructing municipal electric and distribution plant. $75,000 up. G. M. Orr & Co., 408 Baker Bldg., Minneapolis, engrs.

Minn., Northfield — City, J. Larson, clk., sketches municipal electric power and light plant. To exceed $50,000. Burns and McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, Mo., engrs.

Mo., Rolla—Curators of University of Missouri, c/o C. H. Fulton, dir. School of Mines & Metallurgy, plans geology and ceramics building, power plant, hall of mechanical engineering, Norwood Hall, deep well, etc. $87,000. Applied for $543,000 P.W.A. grant. C. V. Mann, c/o owner, engr.

Mo., St. Louis—City, Bd. P. Wks, City Hall, plans by A. Osburg, power plant and service building for city hospital. $250,000. Appropriation ordinance passed. W. E. C. Becker, city engr.

N. J., Trenton—Bids Aug. 7, by Dpt. Institutions & Agencies, State Office Bldg., Trenton, power house addition, coal hoppers, equipment, at State Hospital. $125,000. C. N. Leathem, Jr., State Bldg., engr.

N. Y., New Hyde Park—Village Bd. appointed D. Holman, village counsel as chairman of committee to study proposed municipal light and water plant. H. Baer, mayor.

N. Y., Rockville Center — Village plans expending $250,000 for municipal light plant. P.W.A. project.

N. D., Jamestown—Municipality plans electric light and power plant distribution system. $650,000. Project voted at local election and will apply for P.W.A. funds. Pillsbury Eng. Co., 1200 2nd Ave. S., Minneapolis, Minn., engrs.

O., Athens—Council authorized L. B. McCune, mayor, to make application for $400,000 loan and grant to finance construction municipal electric light plant. If approved Government would make an outright grant to the city of $180,000 and would lend $220,000.

O., Lima—Municipality voted not to apply to P.W.A. for fund to finance construction of electric power and light plant. Project indefinitely deferred.

O., St. Mary's — Municipality plans electric light and power plant. $185,000. Plans application to P.W.A. for aid.

Okla., Hollis — City plans municipal light plant. $75,000. P.W.A. funds applied for. V. V. Young & Co., Colcord Bldg., Oklahoma City, engrs.

Okla., Vinita—State Planning Bd., Capitol, Oklahoma City, plans hydro-electric power development in Grand River, near here. $15,000,000. Applied for P.W.A. funds. V. H. Cochran, Tulsa, engr.

Texas—U. S. Eng., Wash., D. C., plans constructing 143 ft. dam, 1,800 ft. wide, part of power irrigation project to irrigate 390,000 acres land in Hayes and Caldwell Counties. $1,800,000.

Tex., Bowie—City voted bonds for electric light and power plant. $60,000. Engineer, c/o Owners.

Tex., Edinburg—Hidalgo, c/o J. W. Ewing, judge, Edinburg, preliminary plans and surveys waterworks system and electric light plant. $150,000. Use would be made by Hidalgo County Buildings and Edinburg Ind. School Dist. Plans application to P.W.A. for funds. Engineer, c/o County Eng. Dpt.

Tex., San Antonio—City plans new power plant and distribution system. Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, Mo., engrs. Report in progress.

Wis., Altoona—Village, G. A. Thurston, clk., making plans constructing 35 ft. concrete dam across Eau River for hydro electric plant. $177,000. Druar & Milinowski, 803 Globe Bldg., St. Paul, Minn., engrs.

Wis., Shawano—Municipal Water & Electric Comn., plans being completed by Auler, Jensen & Brown, Oshkosh, altering and constructing 2 story, 52x110 ft. addition to power house, fire station and garage.

Wis., Milwaukee—Schlitz Brewing Co., 235 West Galena St., plans new power house, North 2nd St. J. G. Schier, c/o owner, engr.

Ont., Stratford — Soya Mills Ltd., H. P. Trickey, mgr., 521 Parkside Dr., Toronto, contemplates improvements to plant, incl. new boiler house and installing special equipment. $30,000.

Que., St. Urbain — Municipality plans by T. Girard, for municipal electric plant.

Egypt, Cairo—Bids Sept. 10, by Ministry of Public Wks., supplying and erecting 3 electrically driven pumping units, at Rasheed Station. Tender forms, etc., at Egyptian Consulates or from Chief Inspection Engineer, 41 Tothill St., London, England.

Manchukuo, Murden—Manchuria Electric Co. appropriates $25,000,000 for constructing 15 power plants, under 5 year program.

Scotland — Glasgow Corporation presenting plans to Government for electrification of railway lines on Ayrshire route, Cathcart Circle and Greenock and Wemyss Bay Line $100,000,000.

South Africa—M. B. Williams, town clk., Capetown, listing intending bidders for constructing generator plant addition, at Dock Rd. Power Station. $3,232,500 voted for buildings, $5,202,500 for machinery. Bids Aug. 15, by Chairman Electrical Supply Comn. for supplying eight 1,500 kw. traction substation for Randfontein Springs Section comprising a/c switchgear, transformers, mercury arc rectifier d/c switchgear, feed equipment, etc. Bloemhof City Engineer taking bids Aug. 31, supplying 3,000 lb. boiler, economizer, steel chimney, 125 kw. steam engine driven set, traveling cranes, condensing and spray cooling plant, switchgear, transformers.